DEVELOPMENT OF COGNITIVE-LINGUISTIC ASSESSMENT PROTOCOL FOR CHILDREN WITH LEARNING DISABILITIES

Register No: 05SLP005
KAVYA.V

A Dissertation submitted in part fulfillment of
Final year M.Sc (Speech-Language Pathology),
University of Mysore, Mysore.

ALL INDIA INSTITUTE OF SPEECH AND HEARING
NAIMISHAM CAMPUS, MANASAGANGOTHRI
MYSORE-570006

APRIL 2007

Dedicated to
"Daddy, Amma
&
Karthik,
Who mean the world to me"

CERTIFICATE

This is to certify that this dissertation entitled ***"Development of Cognitive-Linguistic Assessment Protocol for Children with Learning Disabilities"*** is the bonafide work submitted in part fulfillment for the degree of Master of Science (Speech-Language Pathology) of the student (Register No. 05SLP005). This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysore

April, 2007

V. Basavaraj

Dr. Vijayalakshmi Basavaraj

DIRECTOR

All India Institute of Speech and Hearing

Mysore-570 006.

CERTIFICATE

This is to certify that this dissertation entitled ***"Development of Cognitive-Linguistic Assessment Protocol for Children with Learning Disabilities"*** has been prepared under my supervision and guidance. It is also certified that this dissertation has not been submitted earlier in any other University for the award of any Diploma or Degree.

Mysore
April, 2007

Prof. K.C. Shyamala
Prof. & HOD,
Department of Speech Pathology,
All India Institute of Speech and Hearing,
Mysore-5 70006.

DECLARATION

This is to certify that this dissertation entitled *"Development of Cognitive-Linguistic Assessment Protocol for Children with Learning Disabilities"* is the result of my own study under the guidance of Prof. K.C. Shyamala, Professor & Head of the Department, Department of Speech Pathology, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier to any other University for the award of any diploma or degree.

Mysore

Apri1, 2007 Register No. 05SLP005

TABLE OF CONTENTS

LIST OF TABLES

LIST OF GRAPHS

ACKNOWLEDGEMENT

/ sincerely thank my guide, **Prof. K.C. Shyamala,** *Professor and HOD, Department of Speech Pathology, AIISH, for her support and guidance. "Thank you Ma'am, for your valuable suggestions, unending patience, words of encouragement and motivation throughout the study. "*

I would like to thank **Dr. Vijayalakshmi Basavaraj,** *Director, AIISH, Mysore, for permitting me to carry out this dissertation.*

It would have been impossible to get through the tough times without you ***Amma.*** *Your cheerful disposition, calming words and incorrigible giggle have made my life. Thank you so much Ma, for making me realize how important it is to face every tough moment with a smile...*

Heartfelt thanks to you ***Daddy,*** *for teaching me important lessons about life and encouraging me to meet the world with courage and determination. I know I am going to remain your little girl always, but no matter how grown up I may be, I will never outgrow my love for you...*

I wonder what I would have done without you being there to give me your unbiased suggestions and unconditional love, ***Karthi.*** *Your warm-heartedness makes you a brother who is special in a way that no one else could be...*

Without your prayers and blessings I would not have achieved anything, ***Velliamma.*** *I am really blessed to have a lovely grandmom like you, thank you...*

I sincerely thank ***Mr. Surendranath Nishanimuth,*** *Principal, Samveda Training and Research Centre, Davangere, for very kindly permitting me to carry out my data collection at such a short notice.*

/ wish to thank all the lovely ***children*** *and staff at Samveda Training and Research Centre, Rotary West School and Pragati School who were such willing participants.*

I express my sincere gratitude to ***all*** *my* ***teachers*** *at* ***AIISH*** *especially Savithri Mam and Manjula Mam for imparting knowledge and being a source of inspiration.*

I also thank all my teachers at JSS...Nataraj Sir, Chari Sir, Suma Mam, Amirtha Mam and Beula Mam for laying the foundation for us and for moulding us into what we are today.

A special thanks to Venkatesan Sir and ***Vasanthalakshmi Mam*** *for all the help rendered during preparation of my stimulus for the statistical analysis.*

I also want to thank ***Rajalakshmi Mam*** *from the bottom of my heart for painstakingly fine tuning my dissertation and changing it to its present form. Thank you too* ***Rakshit...*** *Thank you both for being therefor me...*

Shruti, Maria, Praveen *&* ***Sarfaraz...how*** *can I forget the wonderful time we spent together during graduation being the 'Famous Five '...thanks guys for all the moral support, encouragement and I wish you all the best in your endeavors.*

Dearest ***Dhriti,*** *thank you for believing in me when I found it difficult to believe in myself...for putting so much thought, care and imagination into our relationship..and for being a friend in so many truly meaningful ways...*

Ruchi, Radhish, Vijay*,* ***Sushmit, Kunal...I*** *will truly treasure the time we spent together and it is going to be a part of my 'best memories at AIISH'...I will miss you all... Thanks a lot...*

Rahana, Pri, Marlu, Ani, Anju, Savi, Suma, Nambi, Johnsi, Swappu, Suppi, Neetu, Sister, Mitu, Rohini, Palash, Ravi, Teena *and all my other classmates...Thank you all for being such great friends and being so willing to help me when I needed it. I hope all of you have a nice life...*

A special thanks to ***Shilpashri Mam*** *and* ***Jayashri Mam*** *for all the timely help rendered during my dissertation and RP work...*

The ***library staff*** *merits special thanks including Lokesh Sir and Raju too, for being very kind and helpful.*

Last but not the least, thanks to ***Shivappa*** *and Prasad for the endless Xeroxes and printouts.*

INTRODUCTION

Cognition refers to all the mental processes by which information is transformed, reduced, elaborated, stored, recovered and used (Neisser, 1997). Cognition involves a wide range of mental processes such as attention, pattern recognition, memory, organization of knowledge, language, reasoning, problem-solving, classification, concepts and categorization (Best, 1999).

Cognitive development is described as concept attainment (Bruner, 1956), the development of thought (Vygotsky, 1962), and intelligence (Piaget & Inhelder, 1969). The most complete and influential theory of cognitive development that is applied to language learning, is that of Piaget (Piaget & Inhelder, 1969).

Piaget's model (1969) tries to explain the intricate relationship between cognition and language, and intellectual development has been explained to consist of four periods, each with a distinctive mental structure. Theorizing about cognitive development is dominated by the views of Piaget, who argues that the growing child passes from stage to stage during development, with each stage characterized by different set of cognitive processes.

There is an intricate relationship between cognition and language, especially the cognitive processes like attention, memory and organization are important for comprehending and producing language (ASHA, 1987). Also the higher-level cognitive processes like reasoning, problem-solving and metacognitive thinking are largely mediated by language.

The relationship between language and cognitive is a point of great theoretical difference and debate. Language refers to the symbol systems used in communication. Language learning occurs in a sequence: stimulus differentiation of regularities in verbal behavior; generation of hypotheses about regularities or rules; testing and evaluating those hypotheses and retaining or modifying hypotheses based on feedback. Much of language learning is a problem-solving activity of hypothesis testing (Hoskins, 1979).

Traditionally, theories of children's cognitive functions have relied almost exclusively on data from normal subjects. However, recent years have seen a growing realization that performances of subjects with information-processing deficits, such as the learning disabled, represent an important source of information about memory performance (Ceci, Lea & Ringstrom, 1980), attention deficits (Keogh & Margolis, 1976) and other psychoneurologic dysfunctions.

Learning Disability is a general term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. These disorders are intrinsic to the individual, presumed to be due to central nervous system dysfunction and may occur across the lifespan (NJCLD, 1987).

Problems in self-regulatory behaviors, social perception and social interaction may exist with learning disabilities (LDs) but do not by themselves constitute a learning disability. Although learning disabilities may occur concomitantly with other handicapping conditions (eg. sensory impairment, mental retardation, emotional disturbance) or with extrinsic influences (such as cultural differences, insufficient or inappropriate instruction), they are not the result of those conditions or influences (Hammill et al, 1987).

The impaired cognitive performance of such subjects may be brought to bear on theories that emanate from both cognitive and neuropsychological frameworks. Cognitive deficiencies of children with Learning Disabilities have documented in the Cognitive and Neuropsychological literature.

Johnson & Myklebust (1967) suggest that children with learning disabilities demonstrate psychoneurologic dysfunctions that affect their language performance, but not their potential. Several investigators have reported of attention deficits in language disordered children and its effect on normal speech and language development and also scholastic performance.

The ability to sustain attention is also mentioned within educational context (Keogh & Margolis, 1976). Douglas (1978) reported that children with learning disabilities differ from children without learning problems in their ability to select or allocate the processing ability, that is, to sustain attention. Ross (1976) also suggested learning disability as a developmental lag in selective attention, that is, the ability to use and sustain attention.

Torgesen (1988), Jorm (1983), Cohen (1982) have reported short-term memory deficits in children with learning disability (LD). These short-term memory deficits for verbal information in children with learning disability resulted because of difficulty in using the elaborative encoding strategies as verbal grouping and verbal rehearsal. These difficulties appear to reduce the effectiveness of attention and memory in processing information. These deficits in memory and attention in turn would result in communication breakdown and also poor scholastic performance.

Different studies have shown that such children have impairment in memory encoding (Swanson, 1987), possibly due to semantic memory deficiencies (Baker, Ceci & Herrmann, 1987) as well as problems in interhemispheric processing (Boliek, Obrzut & Shaw, 1988).

The cognitive processes of attention, memory and perception are related to each other and also to language development. In processing the written language, the learner is confronted with the combination of abstract concepts and complex language. Therefore in order to understand the reading and writing problems experienced by children with learning disability, it is very important for a Speech-Language Pathologist to understand the process of interaction between these cognitive processes and language.

In the Indian context, cognitive-linguistic skills have been assessed in the normal population - in children and in geriatric population. One such study was Development of Cognitive Linguistic Assessment Protocol for children (CLAP-C) by Anuroopa (2006) which evaluated the cognitive-linguistic skills in normal Kannada-speaking children in the age range of 4 to 8 years, in different domains like attention/discrimination, memory and problem solving.

Need for the study

There are a few tests which have been developed in the Western context to assess the cognitive-linguistic skills in children with the norms of being restricted to the Western population. Some of these include: The Wechsler Intelligence

Scale for Children (Wechsler, 1949); The Wechsler Preschool and Primary Intelligence Scale (Wechsler, 1968); Cognitive Abilities Test (CAT) (Thorndike, Hagen & Lorge, 1972); Cognitive Linguistic Improvement Program (Ross-Swain, 1992). But most of these tests focus on one or a few of the cognitive-linguistic domains.

Cognitive-linguistic skills in children have not been widely explored in the Indian context. Very few tests such as CLAP-C by Anuroopa (2006) are available to test the cognitive-linguistic skills in Indian children. In particular, there are few studies on the cognitive-linguistic skills in the disordered population in Indian context. There have been no studies of children with cognitive-linguistic impairment as seen with LD.

According to global literature on learning disability, about 1% of children are born with severe language disability and upto 17% may experience varying levels of language disturbances. Dyslexia, a common form of learning disability, is observed in 10% of the school-going population (Silva, Williams & McGee, 1987). Thus, there is a need to study all the cognitive-linguistic domains in this disordered population.

REVIEW OF LITERATURE

Especially at the beginning of life, but also throughout, cognitive functioning is only partially autonomous but is to some degree an aspect of the overall adaptation of the human organism. It goes on at a smoothly integrated or distorted and confused or disintegrated level, depending to a varying extent on the level of integration of the child as a whole (on the intactness of the central nervous system), and on his (or her) interaction with environmental circumstances which may enhance or interfere with this development.

Use Mattick & Lois B. Murphy,
Cognitive Studies, 2: Deficits in Cognition.

In the Piagetian context, language is described as one of five symbolic processes namely, deferred imitation, play, drawing, mental imagery, and language. These processes are part of an active and ongoing process of construction that develops systematically; they are altered and built upon by means of reorganizing, reconstructing, and constructing knowledge.

According to Piaget (1969), intellectual development consists of four periods or stages, each with a distinctive mental structure. His model tries to explain the intricate relationship between cognition and language. These four stages are as follows, in sequence:

1. Sensorimotor period (Birth to 2 years).
2. Preoperational period (2 to 7 years).
3. Concrete operational period (7 to 11 years).
4. Formal operational period (12 to 16 years).

The **sensorimotor period** is marked by development of goal-directed behaviors (4 to 8 months), object permanence (6 to 12 months), and symbolic representations (18 months to 2 years). During this period, egocentric speech develops. During the **preoperational period,** language symbolic functions develop rapidly. Between 2 and 4 years, preconceptual thinking occurs. Between 4 and 7 years, intuition develops. During the **concrete operational period,** the child internalizes principles such as reversibility. The child relates to only concrete objects and events. Terms denoting relationships are understood and rules are used to regulate cooperative activities. **Formal operational period** characterizes adult thinking. During this period, the individual reasons using symbols. Sophisticated hypothesis testing behaviors are observed. Language is used to hypothesize, mediate, and reconstruct knowledge. The individual evaluates hypotheses with feedback from internal (cognitive) and external (environmental) structures.

Piaget's stages of cognitive development are transitional periods involving increases in logic and thinking. The child actively integrates and constructs knowledge about his or her world. Language, as a symbolic function, is the tool for social adaptation. Language develops after certain cognitive structures such as attention, perception, memory and problem solving are developed, and thus, is dependent upon cognition. The different cognitive abilities show a developmental pattern during language acquisition.

Attention

Attention is the taking possession by the mind in clear and vivid form one, out of what seems several simultaneously possible objects or trains of thought.

William James (1890)

In his first textbook on Psychology, William James referred to attention as the "searchlight of consciousness". He meant that attention involves scanning the environment and focusing on selected items (James, 1890). Attention is akin to a "beam of light in which the central brilliant part represents the focus" (Hernandez-Peon, 1964).

Attention is the process of stimulus selection (Neisser, 1976) or selective perception (Gibson, 1969). Ross (1976) described three primary aspects of attention. These were arousal, attentiveness, and concentration. Arousal was associated with a physiologic dimension (i.e., a continuum in which sleep is at one extreme and wakefulness is at the other). Attention referred to the readiness of the organism to perceive and process incoming stimulation. Concentration referred to whether or not attention was global or specific.

Learning disabilities (LDs) and attention disorders are assumed to be different entities. Whereas LDs are characterized by the specificity of dysfunction (e.g., a deficit in reading or spelling), attention disorders tend to be relatively diffuse and affect functioning in a wide range of contexts. Not everyone agrees with the position that attention disorders and LDs are essentially different (indeed, some have thought that LDs was caused by attention disorder), but this view is consistent with that which was put forward in the National Conference on Learning Disabilities (1987). Although LDs and attention disorders are different, they often occur together.

Posner & Boies (1971) describe active attention as vigilance and sustained attention, divided attention and selective attention. All these above mentioned types are important to the child in learning.

Vigilance and Sustained attention

Vigilance refers to the readiness to respond. A child may be considered to have a problem with vigilance if he or she is unable to listen for the next spelling word the teacher presents during a test. The child who is unable to remain "on task" to complete it may be experiencing a problem with sustained attention or persistence (Goldstein & Goldstein, 1990). Vigilance and sustained attention require us to maintain alertness and accurate observation during a long task.

Gaddes & Edgell (1994) measured a child's ability to sustain attention on a boring task (usually a minimum of 10 minutes), using a continuous-performance task. The child was asked to monitor a series of letters, presented on a screen, and then respond when a specific target is present (e.g., trial one, the letter x; trial two, whenever the letter x is preceded by the letter a). The child must try to suppress any response to nontarget stimuli.

The ability to sustain attention was also mentioned within an educational context by Keogh & Margolis (1976). These researchers analyzed attention into three components. These were (1) coming to attention; (2) making decisions; and (3) sustaining attention. Coming to attention involved two aspects - extraneous and possibly disruptive motor activity, and the selection and organization of salient irrelevant aspects of the task. Keogh (1971) suggested that hyperactive children demonstrated deficits at this level of attention. Keogh and Margolis suggested that children with learning disabilities may have problems with any of these components.

Divided attention or Alternating attention

Goldstein & Goldstein (1990) defined divided attention as the ability to track two sources of information simultaneously, such as reading a book and knitting, or listening to the teacher and taking notes (Goldstein & Goldstein, 1990). The automaticity of these learned skills enables a subject to divide attention between the two tasks. The ability to alternate one's attention depends upon learning, practice, memory, and the systems that we have developed for storing and retrieving information.

Divided attention has been measured by having the child complete tasks that involve working with two or more cognitive concepts simultaneously (e.g., alternating between alphabetical and numeric sequences).

Selective attention

Selective attention can be defined as the ability to maintain attention on a target stimulus when distracters are present. One way to measure visual selective attention is with a visual search task. Here the child is asked to find a target letter or shape embedded in a long list of other distracting letters and shapes. Successful completion of such a cancellation task requires selective attention: the child has to pay attention to the main stimulus and ignore the incidental stimulus, scanning the array visually until the target is found.

Attention is a basic information process that is frequently defined within the context of perception. Perception is the integration of sensory stimulation with the anticipatory schema of the perceiver (Neisser, 1976). Attention is part of three ongoing processes: attention and perception, attention and memory, and attention and cognition (Pick et al, 1975).

Developmental trends associated with attention are not clear-cut; perception changes with age and experience. Wright & Vlietstra (1975) summarize the development of attention within the context of their search-exploration theory. Preschool children tend to attend to the most salient characteristics of the stimulus, to position cues, and to random items. Between 5 and 7 years of age, children scan a visual array more systematically, though scanning is still erratic. Around 8 years of age, children can direct attention toward a recognized goal. Older children, 10 to 14 years, increase instrumental or instructional learning and recall more central or task-relevant information (Hagen &Kail, 1975).

In general, most of the authors concluded that processing of global characteristics to more specific attributes occurs with development. This was referred to as selective attention by Neisser (1976), or selective perception by Pick (1975), reflecting the interrelationship between attention and perception. The most prevalent view, with respect to the role of the perceiver, was that stimulation was perceived and processed by an active participant rather than a passive observer.

Memory

Memory is defined as stored representation and the process of encoding, consolidation and retrieval through which knowledge is acquired and manipulated (Chapey, 2001). Attention and memory are different but related processes fundamental to learning. Attention to a stimulus allows it to be more fully and permanently entered into memory, whereas unattended input is fleeting and may be lost. Memory enables the past to be recorded and accessed so that it may affect the present.

The act of remembering involves a number of cognitive processes related to the acquisition, retention, and retrieval of information. To remember, one must first have learned or acquired the information. Next, the information is filed away or retained for later use. The final stage is retrieval, the point of trying to remember. Many failures to remember are failures of retrieval and not of storage. Previously acquired information can be obtained in two ways: by recall or by recognition.

Not all the components of memory develop at the same rate. Some appear to function more or less in the same way in five-year-olds and adults, and other processes continue to develop throughout childhood, adolescence, and adulthood (Kail & Hagen, 1982). The study of these complex memory processes has generated a great deal of information, some of which is summarized here.

The logic for relating attention and memory was established by William James. In his chapter on attention (James, 1890), he wrote that the immediate effects of attention are to make us perceive, conceive, distinguish, and remember better than we could otherwise. Aristotle, usually considered the first psychologist (Watson, 1963), appears to be the first to write systematically on memory. Aristotle recognized that perception and attention must precede memory.

Hebb, 2000 years later, commented that "no learning is possible without intention to learn, no memory of a sensory event is possible unless it was attended to at the time of its occurrence" (Hebb, 1949). Sometimes events peripheral to the focus of attention are remembered, but usually attention enhances learning and memory, which appears to be true in most of academic learning.

Structural Components of Memory

The Sensory Register

Sensory memory refers to the first representation of information that is available for processing for a limited time - about 3 to 5 seconds. Sensory registers probably exist for all the senses, but the ones studied intensively thus far are vision and audition. In the visual modality, the image is referred to as the *icon* (Sperling, 1960). In the auditory modality it is referred to as the mental echo (Darwin et al, 1972). The icon and mental echo last for only a brief period.

Transfer from sensory register to short-term memory

The transfer of information from the sensory register to short-term memory is believed to be controlled by the processes of *pattern recognition* and *attention. Pattern recognition* is the process of recognizing that information in the sensory register is familiar or meaningful. As the information is recognized, it is transferred into short-term memory. The control process of attention governs which information will pass from the sensory register to short-term memory. Thus we are able to attend to only one channel of information at a time.

Short-term Memory

The short-term memory (STM) is a temporary storage system with a capacity to store a limited amount of information for a limited time. It processes information for about 3 to 7 seconds and primarily deals with storage and not retrieval. Of the several short-term memory systems, the most intensively studied are verbal short-term memory, visual-verbal short-term memory, and visual-spatial short-term memory.

In the experimental literature of short-term memory, it has become conventional to differentiate between limitations in capacity and the amount of information that can be retained and reproduced, and limitations in duration of short-term memory and the rate at which material is forgotten. Grouping information allows more to be stored in short-term memory. Meaningful information is more easily stored than nonmeaningful information. Short-term memory is limited by the amount of information that can be stored and also by its duration.

Miller (1956) reported that the number of items recalled by children improved as a function of age with the average score for a 4 year old being about 4 items, whereas for a 9 year old it is 6 items and 7 or higher items for children above 12 years. Ornstein, Naus & Liberty (1975) have established that as children grow older, there appears to be an enhancement in the recall strategies used by them. The younger subjects tend to recall the item presented recently (Primacy effect) and the older subjects tend to use cumulative rehearsal strategies such as sub-vocal rehearsal, chunking, mnemonics etc. which in turn results in integrated units and a better recall.

Working Memory

Working memory is dynamic and active because it focuses on active interpretation of newly presented information as well as on integration of previously stored information as reported by Baddeley (1986). The working memory model is conceptualized as having three major components: the articulatory loop, the visual-spatial sketchpad, and the central executive.

Neisser (1976) explains that working memory allows for temporary storage of information in the articulatory loop or in the visual-spatial sketchpad, which is overseen by a central executive function. The ability to hold material verbatim in working memory is important in problem solving. The central executive system monitors and coordinates the functioning of the memory systems and decides the order in which processes will be performed.

Long-term memory

Long-term memory (LTM) is storage of information, permanent as long as the brain is free of pathology. The information that is stored is primarily semantic. Transfer of information from short-term to long-term memory is governed by a control process, referred to as elaborative rehearsal. The meaning of new information is analyzed and related to information that is already in long-term memory as reported by Craik & Tulving (1975). Most information in long-term memory is stored by semantic coding - that is, by remembering the general meaning of a word or sentence. A second way to encode meaning is by imagery, that is, by creating a mental image of an object or scene.

Information stored in long-term memory can be broken down into two major categories: procedural and declarative memory. Procedural memory is the memory of skills. These are memories of actions and motor skills that have been gained by observing others and by practice. Declarative memory or memory of facts is memory for specific information.

Declarative memory can be subdivided into two types: episodic memory and semantic memory (Tulving, 1973). Episodic memory is autobiographical and is responsible for storing the events of our lives. It is linked to place and time. Semantic memory is more general and includes information such as rules, concepts, and facts.

Problem Solving

Problem solving is a thought process. Hayes (1978) defined a problem as the "gap that separates us from the present state and goal state." Problems come in many different forms and there is no single, clearly defined cognitive operation called "problem solving." Rather problem solving involves a variety of cognitive processes and the importance of any process varies from one problem to another as given by Metcalfe & Wiebe (1987).

The topic of problem solving has been studied in several traditions in Psychology. The Gestalt psychologists examined it many years ago, with emphasis on holistic aspects like restructuring the problem and combining elements in new ways. The behaviorist tradition studied problem solving from the perspective of analyzing it into simple processes of learning responses to stimuli and achieving the solution incrementally. Finally, the computer-influenced information-processing tradition has dominated recent research.

The entire problem situation may be subdivided into (a) understanding the problem, and (b) solving the problem. Considering a problem as a sequence of continually changing states from the start to the finish, there are several aspects to understanding the problem. The initial situation (start state) of the problem must be understood. Another important aspect of understanding the problem is defining the *goal state.* Problem solving must be goal-directed, even though that goal may not always be achieved.

The actual solution of the problem may be viewed as searching through the "problem space" for a "solution path", a path connecting the start state and the goal state. Procedures used in solving problems may be either algorithms or heuristics.

a. **Algorithms** are strategies guaranteed to produce an answer to the problem. Algorithms may not always be efficient, but they always work. They are most useful for well-defined, highly structured problems.

b. **Heuristics** are rules of thumb that have been developed from experience in solving problems. Heuristics involve using hunches, good guesses, practical knowledge, and experience.

All problem solving necessarily begins with the recognition that a problem exists. Problem solving, thus, consists of recognizing a problem and doing mental work to achieve a goal. The Gestaltists customarily thought that problem solving proceeded in a sequence of fixed stages. According to Wallas (1926), these stages were:

1. **Preparation.** In the preparation stage of problem solving, the solver has recognized that a problem exists, and some preliminary attempts have been made to understand and solve the problem.
2. **Incubation.** If the preliminary attempts fail, the solver may then put the problem aside for a while. At least on a conscious level, the thinker is no longer working on the task. At some unconscious level, though, work proceeds.
3. **Illumination.** Illumination is the famous flash of insight that ends the unconscious work and brings the answer to the surface of consciousness.
4. **Verification.** The verification stage confirms the insight. Generally, this stage is the least complicated and usually is nothing more than simply checking to make sure that the insight worked.

Problem solving, like any other human activity, is constrained by the nature of the system. Norman & Bobrow (1975) have outlined the major features which affect problem solving:

- Attention to environmental information is limited and selective.
- Performance on a task is a joint function of the quality of data available and the allocation of processing resources. Both immediately available environmental information and content held in short-term memory (STM) constitute data. When task demands exceed this limit, performance is likely to decline gradually.
- Processing resources are required to maintain content in STM. Maintaining content in STM and operating on that content compete for the limited resources available.
- Information is both entered into and retrieved from long-term memory (LTM), which has unlimited capacity. Entering information into LTM requires

processing resources, and information in LTM is retrieved based on the processing demand.

- The major processing steps in problem solving occur in an essentially serial (rather than parallel) fashion.

These features place constraints on the manner in which children will attempt to solve problems and suggests various ways in which difficulties can be encountered. If the problem situation is information-rich, the child might be unable to take in the necessary information or might select poor information on which to base problem solving efforts. If solving a problem requires retrieval of information from LTM, failure can occur simply because retrieval is not effective.

Memory and Problem solving

Solving a complex problem involves both retrieval of information from LTM as well as processing and maintenance of current information in STM. Both kinds of memory affect problem solving in important ways. It is important to recognize that problem solving requires active memories (those in STM). An individual might have stored the information in LTM, but nothing will be done with that knowledge until it is activated (brought to STM). Problem solving imposes requirements because the child must not only hold information in STM but also operate on it.

Problem solving is also affected by what a child knows i.e. what he has stored in LTM. In order to discuss problem solving in relation to LTM, it is useful to distinguish between propositional knowledge and algorithmic knowledge (Greeno, 1973), both components of semantic memory. Propositional knowledge refers to what people know about things. Algorithmic knowledge refers to rules or procedures for doing things.

A child with increased knowledge can have multiple advantages in problem solving. The more knowledgeable child might know a better way to represent the problem information, have information which helps in identifying critical problem features and in constructing solution plans. Increased knowledge leads to more organized solution attempts, one consequence of which is a reduced load on STM during problem solving. In effect, relevant factual knowledge can change a task from one requiring an extended sequence of operations to one which can be solved simply by retrieving the answer from LTM.

Concept Organization

Concept organization is the combination of concepts in different relationships. Concept learning or discrimination learning is responding selectively in the presence of multiple stimuli (Reese, 1976). Concept organization is a problem solving activity that requires, in sequence: selective attention, response generation, response execution and appropriate response to feedback.

Three types of concept organization tasks are Simple concept selection, Concept formation, and Complex concept selection. Simple concept selection tasks involve two dimensional stimuli and require the child to demonstrate a preference for a hypothesis or identify instances of a predetermined concept (Restle, 1962). Concept Formation tasks involve stimuli that can be grouped in a variety of ways and require the child to select a specific relationship over other possible relationships (Bruner et al, 1966). Complex Concept Selection tasks involve multidimensional stimuli.

Evidence from various clinical population in different cognitive-linguistic domains

Research on childhood language disorders have reported that various cognitive-linguistic processes such as attention, perception, memory, problem solving are impaired in children with developmental disabilities such as ADHD, autism, SLI, MR etc.

ATTENTION

Attention-deficit hyperactivity disorder (ADHD)

It has been discussed that children with ADHD have cognitive processing difficulties, and it frequently co-occurs with LD. Douglas (1983) suggests that these children have greatest difficulty in sustaining attention to a task. Usually, by the first grade in school, children can be expected to sit and work for upto an hour. The inability of children with ADHD to remain on task often results in "behavioral disinhibition" and the seeking out of more engaging activities as reported by Barkley (1990). This disinhibition appears as distractibility and impulsivity. As a result, inattention and disinhibition combine to affect their ability to remain on task.

Children with ADHD tend to be overactive, easily aroused and restless. Such children also have difficulty in thinking before they act, and often do not think about the consequences of their behavior. They often appear impetuous, unthinking, and do not learn easily form their experiences. They invariably have difficulty in working toward a long-term goal. The majority of clinic-referred children does poorly in school and typically underachieves relative to their intellectual level, mainly because of their inattentiveness, restlessness and impulsivity. Research by Douglas (1988) shows that, children with ADHD may have a generalized self-regulatory deficit that influences the organization of information processing, i.e. deficit in the role of attention while information is being processed and the inhibition of inappropriate responding.

Autism spectrum disorders

Autism involves a basic impairment in social cognition. Abnormalities in social behavior co-exist with aberrant attention and deficient language. In the attentional domain, attention to people and socially relevant stimuli is impaired. Also children with Autism Spectrum Disorders (ASD) are characterized by impairments in face recognition and decreased attention to faces. In addition to this, poor cognitive shifting has been found in children with autism by Teunisse & de Gelder(2001).

Mundy & Peter (1997) found that the social and communication disturbance of autism is characterized by a syndrome-specific pattern of strengths and weaknesses, rather than a pervasive lack of responsiveness to others. In children with language, this pattern is manifest as relatively well-developed phonological, syntactic, and semantic facilities, but impaired or deviant pragmatic capacities. In preverbal children, communication for instrumental or attachment functions may be observed, but joint attention, as well as other more purely socially oriented bids are often lacking.

Peculiar attentional behavior has been reported to be one of the components of the social communication deficits in autism. Children with autism show attentional preference to objects over people and a lack, of a drive to communicate. Consistent with this, Swettenham et al, (1998) found that 20-month-old infants with autistic features made significantly fewer attention shifts than did their controls from person to person and between a person and an object. These children spend more time looking at objects and less time looking at people.

But there have studies which contradict the finding that children with autism have difficulties in shifting attention. Pascualvaca et al, (1998) investigated these children's deficit in shifting focus. He found that children with autism could focus on a particular stimulus and sustain this focus as indicated by their performance on the digit cancellation task. Their performance on the card-sorting task suggested problems in some aspects of shifting attention (i.e., disengaging attention). The autism group performed as well as controls, however, they required successive comparisons between stimuli. This implies that they could, in fact, shift their attention continuously. In addition, they did not differ from controls on the computerized matching task suggesting that they do not have a general deficit in shifting attention.

Thus it is very important for a Speech-Language Pathologist to assess these attentional deficits in children with autism. This would further help us in framing appropriate goals for their intervention.

Specific language impairment

Specific language impairment is a developmental language disorder in the absence of neurological, sensori-motor, nonverbal cognitive or social emotional deficits. Cantwell & Baker (1985) have reported that children with SLI are at greatly increased risk for attentional activity problems. Another area in which deficits have been explored is the rate of information processing and responding, particularly in the auditory modality.

Tallal (1976) reported that children with SLI have difficulty processing brief or rapidly presented auditory stimuli. Normal children were able to discriminate two 75-msec tones separated by an interstimulus interval (ISI) as short as 8msec, while individuals with SLI required an ISI exceeding 300msec to perform the same discrimination at the same level of accuracy.

Hanson & Montgomery (2002) investigated the potential influences of general processing capacity and sustained selective attention on the temporal processing of children with specific language impairment (SLI) and age-matched controls. Results showed that on the identification task, SLI children performed more poorly than controls. Results were interpreted to suggest that these SLI children did not evidence a basic temporal processing deficit. No group difference was found in sustained selective auditory attention which shows that selective attention does not mediate their poor temporal processing.

Mental Retardation

One of the most noticeable characteristics of retarded children is that they are poor performers. Their mental and physical activities, at least those that require attention and skill to carry out, are slower, less accurate, less consistent, and less easily improved than those of their intellectual superiors. These differences are those which indicate fundamental processing differences. In general, individuals with mild retardation exhibit equal or slightly greater ability to sustain attention or orient when compared to their mental age matched peers (Karrer, Nelson & Galbraith, 1979). However individuals with mental retardation have difficulty in identifying and maintaining attention to relevant stimulus dimensions.

MEMORY

Attention-deficit hyperactivity disorder (ADHD)

The nature of memory function in ADHD has been extensively researched by investigators. Working memory (WM) has been hypothesized to be impaired in children with ADHD. However, there are few studies reported on tests measuring visuo-spatial WM (VSWM) in ADHD. Westerberg et al, (2004) used a VSWM test was, which had not been used previously in ADHD research. The sensitivity of the VSWM test and a Choice Reaction Time (CRT) test was evaluated in a pilot study by comparing them to two commonly used tests in ADHD-research; the Continuous Performance Test (CPT) and a Go/no-go test, in children with and without ADHD. The groups differed significantly in performance on the VSWM test and CRT but not on the CPT or on the Go/no-go test. Their results show that the VSWM test is a sensitive measure of cognitive deficits in ADHD and it supports the hypothesis that deficits in VSWM is a major component of ADHD.

Wu, Anderson & Castiello (2006) investigated working memory (WM) in children with ADHD using a task switching paradigm with Stroop color-word stimuli which required participants to switch from color-naming to word-reading. Results indicated that children with ADHD had slower response times and less accurate responses. Also, impairment in coping with higher task demands (i.e., high WM load condition) was found. These results do not support the previously documented association between ADHD and a primary deficit in WM for task switching. However, children with ADHD do demonstrate a specific difficulty in slowing down for a demanding task. The findings of this study suggest that earlier proposals of under-arousal and poor state regulation in ADHD deserve renewed attention.

Autism spectrum disorders

Memory has been characterized as the cardinal cognitive domain largely responsible for the clinical manifestations of the disorder or as secondary to a more generalized cognitive deficit that transcends memory, such as executive dysfunction.

Williams, Goldstein & Minshew (2006) created a profile of the memory function in children with autism. The resulting profile of memory abilities in the children with autism was characterized by relatively poor memory for complex visual and verbal information and spatial working memory with relatively intact associative learning ability, verbal working memory, and recognition memory. They reported that spatial working memory discriminated most accurately between the autism and normal control groups.

There are studies which report that children with autism have intact verbal working memory. Verbal and spatial working memory were examined by Williams, Goldstein, Carpenter & Minshew (2005) in high-functioning children with autism compared to age and cognitive-matched controls. No deficit was found in verbal working memory in the individuals with autism using an N-back letter task. The distinction between the N-back task and others used previously to infer a working memory deficit in autism is that this task does not involve a complex cognitive demand. Deficits were found in spatial working memory. Understanding the basis for the dissociation between intact verbal working memory and impaired spatial working memory will provide valuable insights into the neural basis of autism.

Inconsistency of findings has always been the hallmark in autism research. This is due to the high degree of variability in the autism population, which may be the result of developmental differences and differences in cognitive levels among subject groups.

Specific language impairment

The language impairment of many children with Specific Language Impairment (SLI) is thought by some to be related in part to memory deficiency. Experimental evidence reveals that children with SLI have deficits in a number of major functions of verbal short-term memory. Weismer, Evans & Hesketh (1999) investigated verbal working memory capacity in children with SLI. The results of this study indicated that children with SLI evidenced significantly poorer word recall than the normal controls. Distinct patterns of word-recall errors were observed for the SLI and normal groups. Their performance on nonverbal cognitive and language measures was also poorer compared to controls.

Mental retardation

Research shows that there is a clear-cut deficit in memory in children with mental retardation. Wyatt & Conners (1998) compared students with and without mental retardation from three age groups on implicit and explicit memory tasks. Consistent with previous research, students without mental retardation performed better than those with mental retardation on the explicit memory task, but there was no difference between groups on the implicit memory task. For both groups implicit and explicit memory increased from age 6 to 8 to age 10 to 12, but did not significantly increase to age 15 to 17. This shows that implicit memory appears to be a relative strength for students with mental retardation and this may be useful in training situations.

PROBLEM SOLVING

Attention-deficit hyperactivity disorder (ADHD)

Whalen & Henker (1991) have shown that in problem solving situations where there is an uncertainty in response, children with ADHD respond in an impulsive fashion. Such children perform less efficiently in social skills than children who approach problem solving situations in a careful reflective manner. Studies regarding the problem solving behavior of reflective and impulsive children have indicated that these children utilize less mature strategies than reflective children of the same age. In addition, longitudinal studies (e.g. Hogg, Callias & Pellegrini, 1986) have demonstrated that impulsive children evidence a delayed pattern of strategic development between the ages of 7 and 9, a pattern seemingly unrelated to intellectual ability.

Autism spectrum disorders

Children with autism are fundamentally challenged in their ability to see significance or implications within a situation, and to engage in flexible thinking.

They have particular difficulty with the three combined processes that determine success in thinking:

1. **Input:** Obtaining and organizing knowledge through sensory awareness and perception to confirm what he knows (limited sense of self).
2. **Control:** thinking through a situation and making actions meaningful (limited ability to evaluate significance).
3. **Output:** Strategies for using knowledge and solving problems, which combine 'what I do' with 'what I know' (tendency to have rigidity of thought resulting in poor generation, transference of understanding and making connections).

Children with autism are often relatively skilled in areas such as visuo-spatial tasks and seem to use rational thinking processes more effectively than 'free flow' processes as reported by Bruner (1966). A child with autism may show a remarkable logical ability in recognizing the behaviors of others through interpreting this in terms of behavior that they have previously experienced. Yet the same child may have considerable difficulty in predicting the future actions of that person. Harris (1989) hypothesized that this lack of empathetic understanding is due to a problem in juxtaposing the rational and free flow thought process.

Specific language impairment

Children with specific language impairment (SLI) have been reported to lag behind age peers in certain cognitive tasks, despite normal range non-verbal intelligence test scores. Sturn (1999) investigated the use of language while engaged in solving a complex spatial problem. It was hypothesized that these delays could reflect some failure to employ language to direct and facilitate thought. The SLI group used less problem-solving speech and fewer modal expressions than their age peers. The differences found were due to overall reductions in the amount of speech rather than any specific failure to use language as a tool of thought. For children in the control groups, greater use of private speech was associated with greater cognitive efficiency; for children in the SLI group the relationship was in the opposite direction, greater use of private speech being associated with less cognitive efficiency. The findings of this study suggest new directions for studies of cognitive deficits in children with SLI.

Therefore, from the above evidences from different clinical population it is evident that the Speech-Language Pathologist should thoroughly assess the cognitive linguistic abilities in these children, since the development of these cognitive processes is very important for language acquisition.

Learning disabilities and cognitive-linguistic abilities

Learning disability is a term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. These disorders are intrinsic to the individual, presumed to be due to central nervous system dysfunction and may occur across the life span. Problems in self-regulatory behaviors, social perception and social interaction may exist with learning disabilities but do not by themselves constitute a learning disability. Although learning disabilities may occur concomitantly with other handicapping conditions (sensory impairment, mental retardation, serious emotional disturbance) or with extrinsic influences such as cultural differences, insufficient or inappropriate instruction, they are not the result of these conditions or influences (Hammill, 1993).

Over the past two decades, a great deal of research has been dedicated to examining the cognitive processing problems of students with LD, with robust findings indicating that verbal working memory and attention deficiencies provide a primary explanation of their below-average reading performance. Research has also focused on the information processing and problem solving difficulties that these children experience in their everyday lives.

LEARNING DISABILITIES AND ATTENTION

In the field of learning disabilities, attention has been studied in two different ways, and in each of these the term attention has been defined somewhat differently. One line of research has been concerned with the possibility that LD is caused by deficiencies in one or more of the components of attention. So, a large number of studies have been conducted in which the performances of LD and non-LD children are compared on various measures of selective attention.

The second line of research has focused on children with attention-deficit hyperactivity disorder (ADHD). Research on ADHD is relevant to the study of LDs because many children with LDs also have ADHD. However, in this area of study, attention is not defined in terms of the components of attention; instead, diagnostic criteria have been developed for use. It should be noted that the terms ADHD and LD stem from different classification systems. ADHD is found in the Diagnostic and Statistical Manual of Mental Disorders, 3rd ed., whereas the term LDs may be found in P.L. 94-142. LD is referred to in the DSM-III-R as specific developmental disorders such as developmental arithmetic disorder and developmental reading disorder, among others.

Role of attention deficits in LDs

During the late 1960s and early 1970s the study of attention shifted to evaluation of physiologic changes (e.g., Dykman et al, 1971) and information processes (Clements, 1966). Dykman and his associates (Dykman et al, 1971) suggested that learning disabilities resulted from an organically based deficit in attention. These deficits were attributed to neurologic immaturity and were manifested as a developmental lag. Deficits in attention were found at the levels of alertness, stimulus selection, and/or vigilance. It was concluded that attention and physiologic deficits changed as a function of maturation and experience.

The exploration of attention deficits in LDs was motivated by the belief that LDs was caused by deficiencies in attention (Ross, 1976). He suggested learning disabilities as a developmental lag in selective attention. This issue was investigated primarily in terms of performance on two types of attention tasks: Selective attention tasks and sustained attention tasks.

Selective attention

Selective attention is the ability to maintain attention on a target stimulus when distracters are present. Hagen (1967) incidental learning paradigm is used to exemplify a selective attention task. In this methodology, a central stimulus (e.g., a picture of an animal) is presented together with an incidental or background stimulus (e.g., a picture of a household object). The subject is told to pay attention to the central stimulus. In a large number of studies, it has been typically found that non-LD children retain more central items than do children with LD. On the basis of these findings, it was concluded that children with LD were deficient in selective attention.

Swanson & Obrzut (1985) investigated learning disabled readers' recall as a function of distinctive encoding, hemispheric processing and selective attention. They reported that orienting instructions influence ear asymmetry and the recall of particular word features. The effects of orienting instructions were found to be pronounced for nondisabled readers but not for learning disabled readers, suggesting that the two ability groups differ in the formation of a memory trace. In this study, higher selective attention scores were found for nondisabled than learning disabled readers, thereby supporting the selective attention model (Obrzut etal, 1981).

One of the difficulties in evaluating the role of selective attention in LDs is that some of the studies are known to have included subjects with ADHD in samples of children with LD. Then one could argue that the deficit in selective attention may have been due to ADHD rather than the presence of LD.

To examine this issue, a few studies have segregated subjects into homogeneous groups of LD subjects with and without ADHD. The findings from these studies support the notion that children with LD are deficient in selective attention. Tarnowski et al, (1986) found that children with LD showed deficient selective attention performance relative to normal controls, whereas children with ADHD and no LDs did not. Richards et al, (1990) obtained a similar result with a letter - distraction task.

While these studies suggest that children with LD are deficient in selective attention, they do not tell us whether or not a selective attention deficit is responsible for the learning problems. To do this, they have to establish that a relationship exists between performance on selective attention tests and measures of either the type of or severity of LDs. Thus far, no such data are available.

Sustained attention

Sustained attention means that one must attend for an extended period of time. Most studies involving children use trial durations of at least 10 min. In this task, subjects are instructed to monitor either visually or auditorily presented individual letters or numbers and are required to respond when a certain target stimulus is present. For example, they might be asked to press a button whenever the letter "x" is preceded by the letter "a". In this task, many stimulus presentations are used, but a few targets are presented. Thus, a subject must be able to maintain attention for an extended period and withhold responding to nontarget stimuli.

The consistent finding for those studies employing the continuous performance task and that have segregated subjects into LD and ADHD groups (Richards et al, 1990; Tarnowski et al, 1986) is that children with LD do not show a deficit on this task. In contrast, children with ADHD tend to make more errors of commission, i.e., make responses to nontarget stimuli as reported by various authors like Richards et al, (1990), Chee et al, (1989). This pattern of behavior is usually interpreted as a reflection of impulsive behavior, which is one of the characteristics of ADHD.

Co-existence of LDs and ADHD

Estimates suggest that at least 30% of children with LD also have ADHD (Lambert & Sandoval, 1980). The reformulation of the definition of LDs by the National Conference on Learning Disabilities (1987) states that attention disorder *can* be a cause of learning problems but it is not the cause of LDs. This suggests that different characteristics of the learning difficulties are associated with ADHD.

Evidence indicates that different cognitive processing difficulties are associated with LDs and ADHD. Felton & Wood (1989) have shown that rote memory tends to pose problems for children with ADHD but not for children with LD. In contrast, one segment of the LD population (children with reading disabilities) tends to show deficits on rapid automatized naming (RAN) tasks (Felton & Wood, 1989), whereas children with ADHD do as well as controls. In RAN tasks, the speed at which pictures of objects, colors, or symbols can be named is measured.

These differences in cognitive processing skills may have important implications for the assessment and treatment of children with LDs and ADHD. The children with LDs appear to have deficiencies in selective attention as well as in RAN tasks. It may be relevant that selective attention tasks and RAN tasks require relatively rapid responses. Thus, children with LDs may have difficulty with situations that require such quick responses. To confirm this, comparisons should be made between tasks that involve selective attention and those that do not, so that relative importance of both processes could be assessed.

LEARNING DISABILITIES AND MEMORY

Research on children with LD on the initial stages of memory (i.e., the sensory register) suggests that in most cases the sensory register functions adequately. Learning disabled and normal children perform equally at the encoding stage of word recognition as reported by Elbert (1984), but children with LD need more time to carry out a memory search. There appear to be minimal differences between LD and normal children in attention to visual and auditory stimuli. In general, current research findings by Swanson (1983a, 1987) suggest that in a large majority of children with LD, the attentional processes are adequate for performance on many learning and memory tasks.

Short-term memory processing in some children with LD is also influenced by errors in phonological coding and poor access to phonological codes, as in recalling similar and dissimilar-sounding names as shown by Shankweiler et al, (1984), Siegel & Linder (1984). The results of a study by Swanson et al. (1989) indicate that working memory in LD readers is inferior to that of normal readers.

Research on long-term memory problems in children with LD suggests that these children experience difficulties in both storage and retrieval. A fairly consistent finding is that children with LD are less proficient in using rehearsal strategies. Bauer (1979) analyzed the ability of children with LD to learn a list of words over a series of trials and found little evidence of a primacy effect (i.e., improved recall of items at the beginning of the list). The primacy effect is thought to be a good indicator of more rehearsal of those items at the beginning of the list and less interference (Swanson & Cooney, 1991). Other researchers like

Wong (1982) have found that although children with LD choose less efficient strategies to store information, they also seem less rigorous in using retrieval cues. Swanson (1986) reported that long-term memory for tasks that require semantic processing seems especially difficult for some children with LD.

Torgesen (1988) investigated the performance of children with learning disabilities on memory span tasks. Based on the experimental analyses, he suggests that the deficits in performance on memory tasks result from inefficiency in coding, or representing the phonological aspects of language. His findings indicate that children in the LD group showed substantial, and very stable, performance impairments on any task that requires short-term retention of sequences of familiar verbal information, whether presented visually or aurally. In contrast, they did not show impairments on tasks requiring the immediate recall of abstract (unfamiliar) visual information on tasks that allow semantic encoding of items or on recognition memory tasks.

Problems of immediate and short-term memory are common among children with learning disorders (Pennington, 1991). Swanson & Cooney (1991), conclude that short-term memory problems in children with LD are associated with the way in which information is strategically processed and the way in which information is mentally represented.

Swanson, Ashbaker & Lee (1996) investigated learning-disabled readers' working memory as a function of processing demands and whether limitations in the enhancement of learning-disabled readers' working memory performance are attributable to process or storage functions. The results indicated that learning-disabled readers' working memory performance was comparable on visual-spatial measures, but inferior to age-matched children on verbal working memory measures. This indicates that learning-disabled readers are inferior on both verbal and visual-spatial working memory measures when compared to age-matched children.

McNamara & Wong (2003) examined how students with LD process everyday information and whether the processing difficulties experienced by students with LD can be alleviated with the use of cues. The study compared students with and without LD on their recall of academic information and information encountered in the student's everyday lives. The results indicated that students with LD performed poorly on both the academic recall tasks and the everyday recall tasks. Given these results, working memory processing problems may manifest in tasks that are not reading based. Specifically, recall performance difficulties occurred in tasks that included the processing of academic, episodic, procedural, and common object information. Although these tasks are quite different in nature, it is hypothesized that a common functional mechanism underlies the performance difficulties of students with LD.

Several recent studies have shown that differences between less skilled readers and skilled readers on measures of cognitive function are related to limitations in working memory (WM) (e.g., Swanson, 2003). Some studies (e.g., Stanovich & Siegel, 1994) have suggested that limitations of WM in children with reading disabilities (RD) are primarily attributed to an isolated storage system that holds and maintains phonological codes. Other studies (e.g., Swanson, 1993) have suggested that difficulties in executive processing also contribute to poor WM performance in children with RD beyond their deficits in phonological processing.

Thus, some differences in storage and executive processing emerged between skilled and less skilled readers that were not specific to reading.

Therefore, future research must focus on the interaction between the executive and phonological systems during the act of reading across a broad age span to disentangle the alternative interpretations. The factors that contribute to comprehension-only deficits relative to skilled readers emerge only at the executive processing level. These results provide support for the assumption that comprehension and recognition deficits reflect deficits from separate memory systems (Swanson, Howard & Saez, 2006).

LEARNING DISABILITIES AND PROBLEM SOLVING

Studies of the problem solving and concept organization skills of children with learning disabilities are organized according to the three types of cognitive organization tasks: Complex concept selection; Concept formation; and Simple concept selection and the implications for the levels of information processing (e.g., selective attention, response generation, and feedback) are discussed below.

Complex concept selection

Freibergs & Douglass (1969) studied concept shift learning children with LD and children without learning problems. Children in both the groups ranged from 6 to 12 years. The authors found that when the children were presented with the concept identification problems, significantly more children in the normal group reached criterion than in the LD group. Also, children with LD performed poorer than normal children under the partial reinforcement condition. These results were interpreted as suggesting that with continuous reinforcement, the child's orienting response to the task was reinforced, resulting in better and more sustained attention.

Hypothesis-Testing Task

Parrill-Burnstein & Baker-Ward (1979) used the hypothesis testing task with children with and without learning disabilities. They found that children with learning disabilities solved significantly fewer problems than those in the comparison group. A significant age effect was also obtained. Children in the first grade solved significantly fewer problems than those in the fifth grade. These developmental findings were similar to those obtained with children without learning problems as studied by Gholson et al, (1972).

Children with learning disabilities tested significantly fewer hypotheses and were less consistent following feedback than were children without learning problems. This type of responding was similar to that observed with younger children without learning problems and was interpreted as reflecting basic problems in selective attention. When children with learning disabilities tested hypotheses, their responses were not always consistent with feedback. Thus, children with learning disabilities solved fewer problems than those without learning problems.

Concept Formation

To evaluate concept formation in children with learning disabilities, Parrill-Burnstein (1978b) used a card-sorting task, and the responses of children with learning disabilities were compared to those without learning problems. Parrill-Burnstein found no group differences in performance when the children were asked to group the items spontaneously. Consistent with other researchers (Annett, 1959), the number of categories formed decreased with age, and the number of items within each category increased as age increased. When the children were told there were five main categories or groups, some children improved significantly in the number of correct categories formed, while others did not.

Simple Concept Selection

Parrill-Burnstein & Baker-Ward (1979) investigated the responses of children with and without learning disabilities to a complex visual theme and to distracter items. The stimulus was a picture of a group activity (e.g., a birthday party), with separate items positioned in the four corners (e.g., bottle, shoe, comb, etc.). The distracters for this task were placed on the periphery but could be considered part of the stimulus by the subjects. The task was to tell a story about the picture.

Children in both the groups did not differ when total words and syntax were considered. Significant differences as a function of content, the ability to abstract about the theme, and integration of the distracters were obtained. With respect to the peripheral items, children with LD mentioned these items significantly less frequently than normal children. Children with LD labeled or enumerated the objects, while normal children integrated them into their story.

Thus, differences in the selective attention and integration of cues were obtained when the responses of children with and without learning disabilities were compared. Differences in the performance of children with learning disabilities and in the presence and placement of distracter items were significant.

Research on children with LD has traditionally focused on their perceptual, language, cognitive, and academic functioning, and there are very few studies on their behavior, social functioning, and family backgrounds. Now, however, research evidence has accumulated suggesting that children with LD show more behavioral problems, and display less social competence. With regard to this, Toro et al, (1990) compared children with and without LD on social problem-solving skill, school behavior and competence, and family background. The results indicated that the children with LD were able to generate fewer alternatives for solving social problem situations, showed less tolerance for frustration and less adaptive assertiveness, and had more overall classroom behavior problems and less personal and social competence in a variety of areas as rated by teachers.

The results of the above studies illustrate the different cognitive-linguistic processing deficits in children with LD and highlight the role of the Speech Language Pathologist in assessing the intact and deficit information processing abilities in children with LD, and based on these deficits to formulate an appropriate plan for remediation of these deficits.

Assessment of Cognitive-Linguistic Skills in Children

Cognitive-linguistic skills in children have not been widely explored in the Indian context. In the Western context many tests have been developed by various authors. Given below are some of the exemplary tests, protocols and scales.

grade, and primary 2 for students in grades 2 and 3. The primary batteries consist of four subtests which are oral vocabulary, relational concepts, multimental and quantitative concepts.

The Kaufman Assessment Battery for Children (K-ABC) (Kaufman & Kaufman, 1983a, 1983b)

The K-ABC was designed for assessing children aged *2 1/2* to 12 1/2 years. This test consists mostly of nonverbal items like pictorial diagrams that require children to perform a variety of information- processing of tasks.

Cognitive Linguistic Improvement Program (CLIP) (Ross-Swain, 1992)

CLIP contains cognitive linguistic tasks that are used to quantify information processing deficits in clients following head trauma. CLIP provides the diverse tasks needed to improve memory skills, orientation, organizational abilities and to strengthen and improve skills, orientation, organizational abilities and to strengthen and improve skills of abstraction, judgment, reasoning and processing.

Cognitive Linguistic Assessment Protocol for Children (CLAP-C) (Anuroopa, 2006)

This protocol is the most recent addition to the research on cognitive-linguistic abilities in children. It contains a hierarchy of subtests which assesses the various cognitive-linguistic areas such as attention, memory and problem solving in children between the ages of 4 and 8 years.

Most of these tests listed above focus on one or a few of the cognitive linguistic domains. Also, the normals of these tests are restricted to the western population. Cognitive-linguistic skills in children have not been widely explored in the Indian context. Very few tests such as CLAP-C by Anuroopa (2006) are available to test the cognitive-linguistic skills in Indian children. In particular, there is a lack of studies on the cognitive-linguistic skills in the disordered population in Indian context. There have been no studies of cognitive-linguistic skills in the disordered population in Indian context. There have been no studies of cognitive-linguistic impairment in children with LD. Considering these factors, the present study aimed to develop an assessment protocol to assess the cognitive-linguistic domains in which children with LD are likely to be deficient.

METHOD

Aims of the study

- To study the developmental pattern of the cognitive-linguistic skills in normally developing Kannada speaking children.
- To develop an assessment protocol for the cognitive-linguistic skills in children with Learning Disabilities.
- To study the cognitive-linguistic skills of children with Learning Disabilities, thereby identifying the areas/ domains in which these children are likely to be deficient.

Material

As this study aimed to construct a Cognitive-Linguistic Assessment Protocol for children with Learning Disabilities in the age range of 8 to 14 years, the review constituted a vital part and the first step of this study.

Item pooling

A review about the different Western and Indian tests/tools/protocols/ checklists used for the assessment of cognitive-linguistic skills, journal articles and web-based search was employed. Thus, all the items pooled from the literature were classified under three different domains - Attention/ Discrimination, Memory and Problem solving, for the present study.

Subjects

The subjects were divided into two groups - Group I and Group II.

Group I - Normal group - consisted of 60 normal, school-going children in the age range of 8 - 14 years.

Criteria for selection of normal group

- Children with normal speech and language development.
- Children with normal hearing abilities and normal visual acuity.
- All the children were able to speak, read and write Kannada.
- All the children had Kannada as their mother tongue and were studying in an English medium school.

***Group** II-* Clinical group - consisted of 24 children with learning disabilities in the age range of 8 - 14 years.

Criteria for selection of Clinical group

- The children with normal speech and language skills.
- Children with normal hearing abilities and normal visual acuity.
- All the children were able to speak, read and write Kannada.
- All the children had Kannada as their mother tongue and were studying in an English medium school.
- The subjects who were identified and diagnosed as LD, as seen by a multidisciplinary team.
- The duration of therapy attended by the subjects of Group II did not exceed six months.

Screening

The subjects of both Group I and Group II were screened for their speech, language and hearing abilities. Linguistic Profile Test (LPT) was used to screen the linguistic abilities of the subjects.

The subjects of both the groups were matched in terms of their chronological age. Teacher's opinion regarding each child's scholastic performance was also considered. Subjects were sub grouped as given in the tables below:

Table 1: Demographic data of the Normal group (Group I)

SI. No.	Age (In years)	No. of Males	No. of Females
1	8 - 9	5	5
2	9 - 10	5	5
3	10 - 11	5	5
4	11-12	5	5
5	12-13	5	5
6	13- 14	5	5
Total no. of subjects		**30**	**30**

Table 2: Demographic data of the Clinical group (Group II)

SI. No.	Age (In years)	No. of Males	No. of Females
1	8 - 9	3	1
2	9 - 10	3	1
3	10 - 11	3	1
4	11 - 12	2	2
5	12-13	2	2
6	13- 14	3	1
Total no. of subjects		**16**	**8**

Procedure

The procedure of this study included five phases:

Phase I: Development of the protocol.

This phase included developing the protocol, and the cognitive processes employed most often in linguistic communication tasks were considered. This was done based on the nature of cognitive-communicative tasks used by authors previously in studying the cognitive-linguistic domains in various populations and selecting those which were suitable for the children with learning disability of the above mentioned age group.

The different cognitive-linguistic domains which were assessed in children with Learning Disabilities were: (a) Attention, Discrimination and Perception (b) Memory (c) Problem solving

.

Each domain was assessed using different tasks as follows:

- *Attention, Discrimination and Perception* included Digit Count Test, Sound Count Test, and Auditory Word Discrimination in Auditory mode, Odd One Out Test, Letter Cancellation and Visual Word Discrimination in the Visual mode.
- *Memory* included Digit Forward Span, Word Recall, and Digit Backward Span in Auditory mode, Alternate Sequence Task, Picture Counting Task, and Story Sequencing in the Visual mode.
- *Problem solving* included tasks such as Predicting the Cause, Predicting the Outcome, Compare and Contrast in Auditory mode, Association Task, Overlapping Test and Mazes in the Visual mode.

The above mentioned tasks were adapted from the unpublished dissertation 'Development of Cognitive Linguistic Assessment Protocol for Children CLAP-C by Anuroopa (2006). The set of items of a task in each domain was arranged in a hierarchy from simple to complex, from first to the fifth level. These hierarchies were structured based on the opinion of the Clinical Psychologist and the required modifications were done in order to suit the population and age under consideration, of this study.

Phase II: Pilot Study

Following the development of the protocol, a pilot study was carried out in which the protocol was administered on 12 normal Kannada speaking children in the age range of 8 - 14 years (Two in each age group). Equal number of males and females were selected for the pilot study.

DOMAIN I

ATTENTION/ DISCRIMINATION

In this domain, two types of attention processes were evaluated, i.e. selective attention and sustained attention, in both the auditory and visual modalities. The cognitive process of discrimination is contingent on attention and therefore it was considered in the same domain.

AUDITORY MODE

Digit Count Test

In this task, the child was instructed to listen to a set of digits presented auditorily and had to count mentally how many times the target digit was read out in the list. The number of units in each level was arranged in such a way that the complexity of the task increased from level I to level V. A score of "1" was given for every correct response and every wrong response was given a score of "0". This task evaluated the sustained attention.

Sound Count Test

Here, the child was instructed to listen to a set of phonemes presented auditorily and had to count mentally how many times the target phoneme was read out in the list. The number of units in each level was arranged in such a way that the complexity of the task increased from level I to level V, as in the Digit Count Test. A score of "2" was given for every correct response and every wrong response was given a score of "0". This task also evaluated the

Auditory Word Discrimination

This task evaluated the auditory discrimination skills, based on the auditory stimulus presented, i.e. trisyllabic words. A pair of similar-sounding words were presented auditorily by the examiner and the child had to respond by saying whether the words were the same or different. A score of "1" was given for every correct response and every wrong response was given a score of "0".

VISUAL MODE

Odd One Out Test

In this task, the child had to scan through a visual array of the stimulus and point to the odd/different stimulus among the set of 4 to 6 pictures. This task of selecting the odd picture required sustained attention. The complexity of the stimulus increased from level I to V, with the last level requiring complex concept organization. A score of "1" was given for every correct response and every wrong response was given a score of "0".

Letter Cancellation

In a simple letter cancellation task, a specified letter appeared repeatedly within a random matrix and this requires sustained attention in scanning the page and marking each instance of the letter. The higher levels included contingent letter cancellation and this task required the fulfillment of contingency before cancellation of the letter. This task evaluated the selective attention. Further as the test level progressed, color was added as a distracter in the contingency-letter cancellation task. A score of "2" was given for every correct response and every wrong response was given a score of "0".

Visual Word Discrimination

This task was included to evaluate the visual discrimination skills for the visually presented trisyllabic word pairs. A pair of similar-looking words were presented by the examiner and the child had to respond by saying whether the words were the same or different. Discrimination deals with the ability to differentiate between stimuli. Attention plays an important role in discrimination. Hence tasks involving discrimination are often employed in testing attentional skills. A score of "I" was given for every correct response and every wrong response was given a score of "0".

DOMAIN II

MEMORY

Memory involves the ability to store, recall and process information. The different subtests which were used to assess memory are given below:

AUDITORY MODE

Digit Forward Span

Digit span is a common measure of short-term memory, i.e. the number of digits a person can absorb and recall in serial order after hearing or seeing them. Here, the child has to remember a small amount of information for a relatively short time, and the order of recall is important. In this subtest, the children had to repeat the set of digits presented auditorily by the examiner. The levels were arranged in an increasing order of complexity, such that the first level consisted of five digits and the last level had nine digits. A score of "1" was given if the serial order of recall was correct and a score of "0" was given if the order was incorrect.

Word Recall

This task required the child to recall and repeat all the words presented by the examiner. This subtest also involved the same hierarchical arrangement as mentioned above i.e. the number of words in the first level was five and increased till the last level, which had nine words. A score of "2" was given if all the words in that level were repeated and a score of "1" was given if 50% of the words were repeated and "0" was given if the number of words repeated was less than 50%.

Digit Backward Span

In this subtest, the children had to repeat the backward sequence of the digit sequence presented auditorily by the examiner. The levels were arranged in an increasing order of complexity, such that the first level consisted of four digits and the last level had seven digits. A score of "1" was given if the backward order of recall was correct and a score of "0" was given if the order was wrong. This task is a very good measure of short-term memory span.

VISUAL MODE

Alternate Sequence Task

A sequence or a pattern of items was presented to the child with a blank, and the child was asked to fill in the blank, based on the four choices given below. This subtest also included the child's attentional skills in addition to memory, to fill the gaps, since the child had to fill in the gap based on the shape, number, color or pattern of repetition. Every correct choice made was given a score of "1/2" and every wrong choice was given a score of "0". There were a total of 10 items and thus the maximum score in this task was "5".

Picture Counting Task

In this task, a set of pictures were visually presented and the child had to recall all the pictures presented after the stimulus was removed from the visual field, by the examiner. The number of items recalled by the child gives us information about the visual memory span of the child. As children differ in the modality of learning, i.e. visual or auditory, this task helps the clinician to identify the dominant modality of learning. This subtest also involved a hierarchical arrangement as mentioned above i.e. the number of pictures in the first level was five and increased till the last level which had nine pictures. A score of "2" was given if all the pictures in that level were recalled and a score of " 1 " was given if 50% of the pictures were recalled and "0" was given if the number of pictures recalled was less than 50%.

Story Sequencing

This subtest required the child to arrange the story cards in the correct sequence as per the story. Five commonly known stories were selected in the increasing order of complexity and the children were asked to arrange the cards as per the story sequence. The story was not narrated if it was unknown, and the children had to infer the sequence on their on. This also evaluates the child's problem solving abilities such as reasoning, inference and creative thinking in addition to evaluating the short-term memory. A score of "3" was given if all the cards were arranged correctly and a score of "2" was given if 50% of the cards were arranged correctly and "1" if less than 50%. No points if the theme of the story was incorrect.

DOMAIN III

PROBLEM SOLVING

In this domain, the different problem solving abilities of the children such as hypothesis-testing, reasoning, creative thinking, concept organization were tested. These skills are also contingent upon the other cognitive processes such as attention and memory.

Predicting the Cause

Problem solving involves understanding the problem, generating possible solutions, overcoming possible obstacles, and evaluating alternatives. This task involved the child to reason, and predict the cause for a hypothetical situation given by the clinician.

For eg. "All your plants have dried up, why?" and the possible answer could be "I did not water the plants" or "Due to intense sunlight".

Thus, a score of "2" was awarded if the cause was stated clearly and is possible. "1" point if the cause was correct but not explained clearly and "0" if the answer was irrelevant. This subtest included a total of ten questions arranged in a hypothetical order from simple to the most complex situation.

Predicting the Outcome

This task required the child to reason out and explain the possible outcomes of a hypothetical situation given by the clinician.

For eg. "What will you do if you get locked up in a room?" and the possible answers could be "I will cry out for help" or "I will try to get out through the window".

Thus, a score of "2" was awarded if the outcome was stated clearly and is possible. "1" point if the outcome was correct but not explained clearly and "0" if the answer was irrelevant. This subtest included a total of ten questions arranged in a hypothetical order from simple to the most complex situation.

Compare and Contrast

This subtest required the child to compare and contrast between a pair of items presented i.e. they had to explain the similarities and differences, by at least two features.

For eg. "Cat and rat".

This task involves the child's *critical or logical thinking,* which is the ability to break an idea into parts and analyze them. Thus, a score of "2" was awarded if the items were compared and contrasted by two features, " 1 " point was given if the items were compared and contrasted by one feature and "0" if the answer was irrelevant. This subtest included a total often word pairs arranged in a hypothetical order from simple to the most complex.

VISUAL MODE

Association Task

In this subtest, the child had to scan through the picture array and explain how the pictures were associated or had to name the category to which all the pictures of the array belonged. This task involves the child's concept organization, critical and logical thinking and reasoning for reaching the solution. The complexity of the task was increased further by increasing the complexity of association in the higher levels. A score of "1" was given for every correct response and every incorrect response was given a score of "0".

Overlapping Test

Here, the child had to look at a picture in which different items overlap and the child had to solve the overlap and had to name the items or pictures depicted in the picture. This task also consisted of five levels arranged in a hierarchy. Each item named was given a score of "1". Totally there are 30 items including all the levels of this task and hence the maximum score is "30" for this task.

Mazes

This task required the child to solve the maze and reach the place of destination showed by the experimenter. The mazes were arranged in an increasing order of complexity from simple to complex. A score of "1" was given for every correctly solved maze and a score of "0" was given if the maze could not be solved.

Colored pictures were used for the various tasks during data collection. The black and white version of these pictures is attached in **Appendix II.**

Phase III: Revision of the protocol.

After the different domains were assessed, suitable modifications were made in order to suit the population under consideration.

Phase IV: Administration of the final protocol on normal children.

The protocol after all the required modifications were made, was administered on the children of Group I. The subjects were selected from schools in Mysore, which had English as the medium of instruction. All the children had Kannada as their mother tongue. They were seated comfortably and were tested in a room with minimum external noise. The testing was carried out in one session, and the time taken was 45 minutes to one hour to administer the whole protocol. The children's responses were scored.

Phase V: Administration of the protocol on children with Learning Disabilities.

In the final phase, the protocol was administered on the children of Group II, after suitable modifications were made in order to suit the population under consideration.

ANALYSIS

The scores obtained after administering the protocol were totaled for each of the subjects of both the groups, in each domain, across all the age groups. Qualitative and quantitative analysis was done. Comparison was made between the children with LD and the normal population in different domains. The domains in which the children with LD had deficits were highlighted and the potential parameters which differentiated normal versus LD population were also highlighted. The mean scores of the children of both the groups, across the age groups were compared and tabulated. In addition, the pattern of development of the cognitive-linguistic skills of normal children across different age groups was graphically represented. The performance of the normal vs. clinical groups in different domains for each age group was also graphically represented.

RESULTS AND DISCUSSION

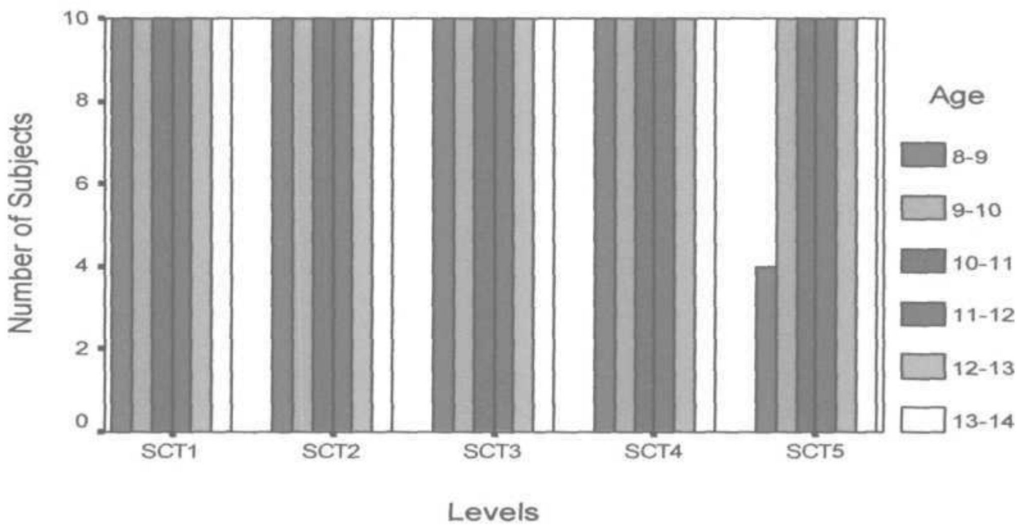
The aim of the present study was to develop a cognitive-linguistic assessment protocol for children with learning disabilities and to study the deficit areas/domains in children with learning disabilities. The protocol was developed considering the Cognitive Linguistic Assessment Protocol for Children (CLAP-C) by Anuroopa (2006) as the base, with suitable modifications in order to suit the population and age under consideration, of this study. This protocol was then administered on normal children in the age range of 8 - 14 years to study the pattern of cognitive-linguistic abilities in these children. Using the obtained norms, the performance of children with LD on the cognitive-linguistic domains were studied and compared across age groups.

The data obtained was tabulated appropriately and was subjected to qualitative and quantitative analysis. At the outset, a descriptive analysis of the performance of all the subjects on each task in all the domains was done. The tasks in each domain were arranged in an increasing order of difficulty such that with every presentation the complexity of the task increased.

To analyze the levels suitable for a particular age group, 50% criteria was followed in order to pass a particular level in each task for the normal group. In view of that, the performance of children with learning disabilities was compared to that of the normal children on each task in each domain and the developmental pattern was obtained.

It is clear from the above graph that all the six groups were able to satisfactorily perform the first four levels of the Digit Count Test i.e. DCT 1, DCT 2, DCT 3 and DCT 4. However, there is a difference observed across different age groups at the most complex level of this test (DCT 5). Only the subjects of 13-14 years age group could meet 100% criteria on this task. But the subjects of all the age groups met the criteria set since more than 50% of them could perform the task.

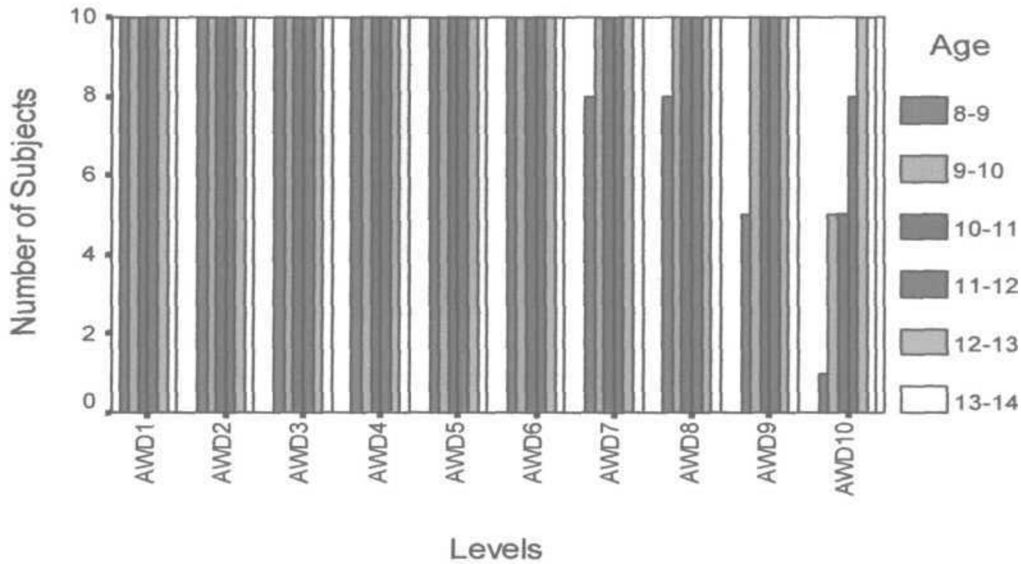
2. Sound Count Test (SCT)



Graph 2: Performance of normal children on the Sound Count Test.

It is evident from the above graph that children from all the six groups were able to accomplish all the five levels of the Sound Count Test, except the first group (8-9 years), wherein a few subjects did perform on SCT 5 but did not meet the 50% criteria. All the subjects greater than 8-9 years age group met 100% criteria for all the levels. This suggests that the attentional abilities of children are well developed by 9-10 years of age.

3. Auditory Word Discrimination (AWD):

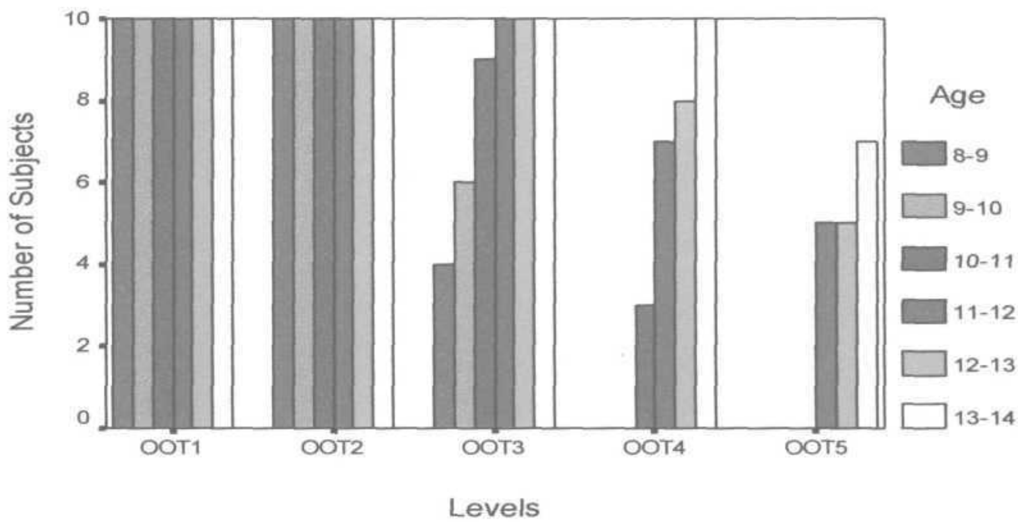


Graph 3: Performance of normal children on the Auditory Word Discrimination test.

In this task ten trisyllabic word pairs were used to assess the auditory word discrimination. The words were hierarchically arranged in the increasing order of complexity. It can be seen from this graph that the older children were able to discriminate all the word pairs i.e. above 11-12 years of age. The children of 12-13 years and 13-14 years age group met 100% criteria on AWD-10. In contrast, in the younger subjects (8-9 years), there was deterioration in the number of subjects performing at the higher levels. The performance of these children on AWD-10 did not meet the 50% required criteria.

II. VISUAL MODE

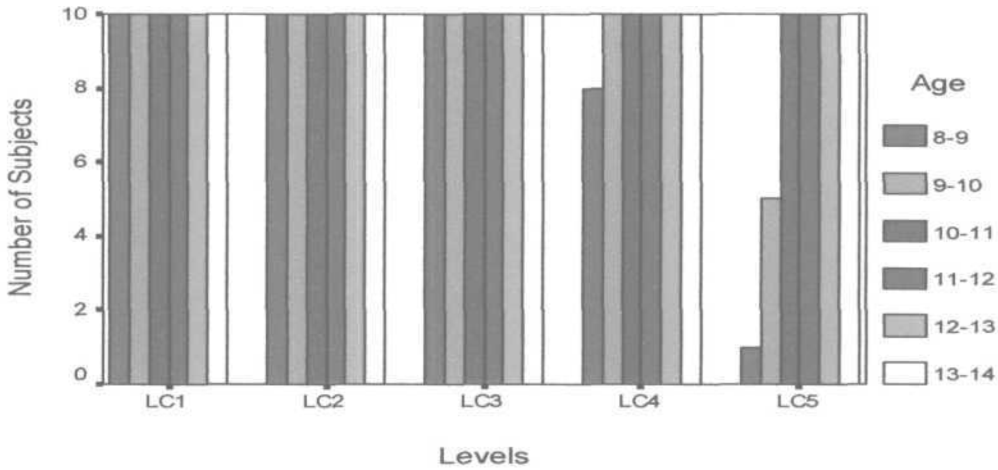
1. Odd One Out Test (OOT)



Graph 4: Performance of normal children on the Odd One Out Test.

It is clear from the graph that the first two levels (OOT 1, OOT 2) of the task were attained by all the six age groups. However, a drop in the number of subjects performing in the higher tasks was observed as the levels advanced from III to V. It can be seen from the graph that the third level (OOT 3) could not be performed by 8-9 year old children. The subjects of 13-14 years age group could meet 100% criteria till OOT 4. The last two levels (OOT 4, OOT 5) could be performed by children of the 11-12 years and older age group, and not by the first three (younger) age groups.

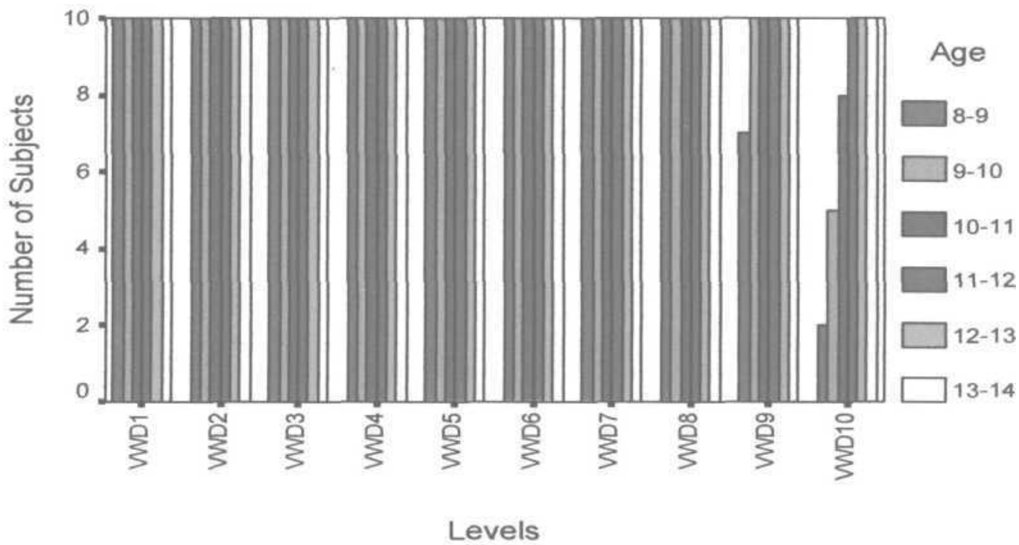
2. Letter Cancellation (LC)



Graph 5: Performance of normal children on the Letter Cancellation task.

It is evident from the graph that all the six groups met the criteria for the first four levels. The last level (LC 5) could not be performed by the 8-9 year old children. A few subjects did attempt to perform on this level but did not meet the required criteria. All the other five age groups could perform on the last level. All children above the 9-10 years age group met 100% criteria for the last level LC 5.

2. Visual Word Discrimination (VWD)



Graph 6: Performance of normal children on the Visual Word Discrimination

In this task ten trisyllabic word pairs were used to assess the visual word discrimination abilities of children. It can be seen from this graph that the older children were able to discriminate all the word pairs. Only the last level (VWD 10) could not be performed by 8-9 year olds.

Thus it was found that as the density of the tasks increased the performance came down. This can be attributed to the greater selective or sustained attention span required for the higher levels. And thus as the age increases the attention span of the children also increases, and by about 10 years the attention/discrimination is fully developed as is evident from the results shown in the graph.

These results are also in agreement with a number of theories proposed to describe the development of attention (Pick, 1975). According to Pick (1975) and Neisser (1976), the processing of global characteristics to more specific attributes occurs with growth and development. Thus in summary, the attentional skills develop as a function of age and thus it is very important for a Speech Language Pathologist to be aware of these developmental trends.

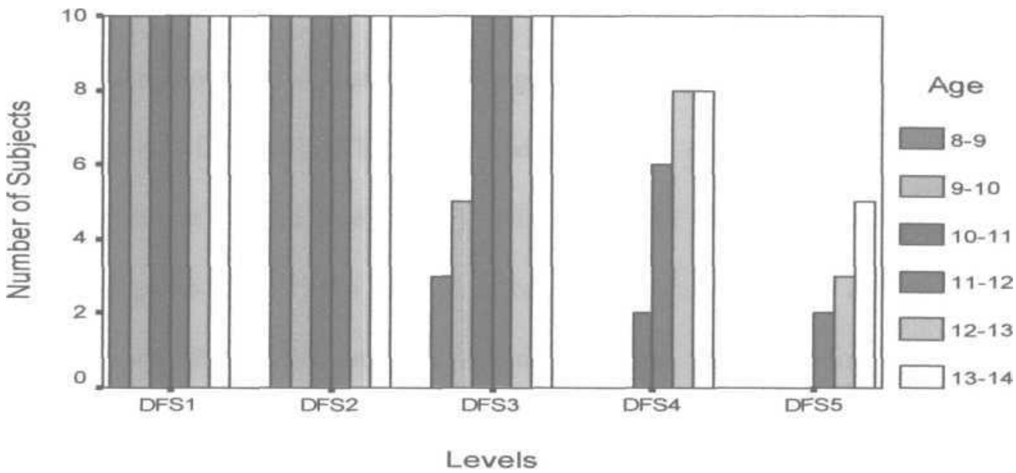
Wright & Vlietstra (1975) summarized the development of attention within the context of their search-exploration theory wherein they report that between 5 and 7 years of age, children scan a visual array more systematically, though scanning is still erratic. Around 8 years of age, children can direct attention toward a recognized goal. Older children, 10 to 14 years, increase instrumental or instructional learning and recall more central or task-relevant information. This is concordant with the present study wherein it was found that the attention abilities of children above 10-11 years was superior to the younger children.

II. MEMORY

The performance of the normal subjects from all the six age groups across all the five levels of the different tasks used to assess memory was compared and is graphically represented below:

I. AUDITORY MODE

1. Digit Forward Span (DFS)



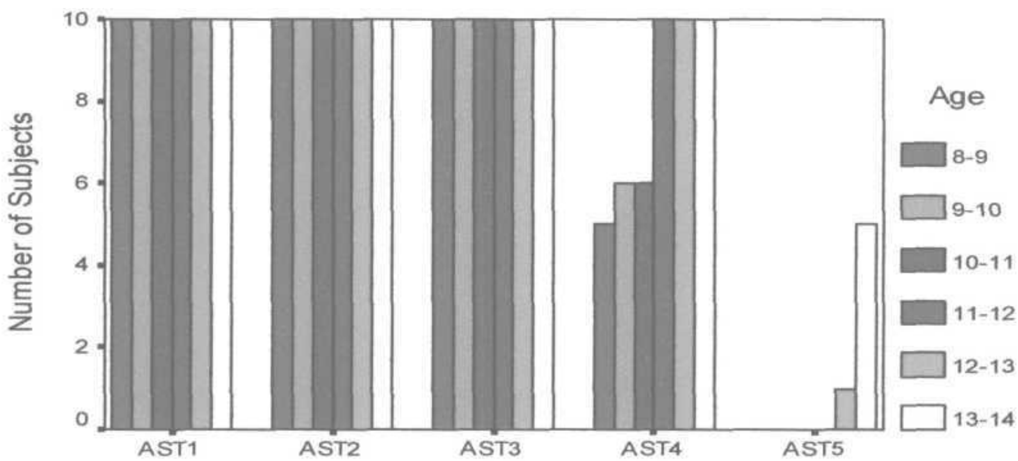
Graph 7: Performance of normal children on the Digit Forward Span.

It is clear from the graph that the subjects from all the six groups were able to attain the first two levels of the task. However, as the levels advanced the performance declined from level III to level V. Only children from 8-9 years group were unable to attain level III. In contrast only 13-14 year old children could pass the 50% criteria for the last level. The younger children could not reach levels IV and V thus indicating that the number of items recalled improves as the age increases.

On Digit Backward Recall test, the overall performance to recall the digits in the reverse sequence was poorer. The subjects were able to recall digits in backward order only in the first two levels (DBR 1, DBR 2). The third level was achieved only by the older children. None of the groups were able to achieve the last two levels (DBR 4, DBR 5), although a few subjects from 13-14 age group did perform on DBR 4 and DBR 5, they did not meet the criteria. It can be suggested from these results that the Digit Backward Recall entails higher cognitive skills which improves as the age advances.

H. VISUAL MODE

1. Alternate Sequence Task (AST)

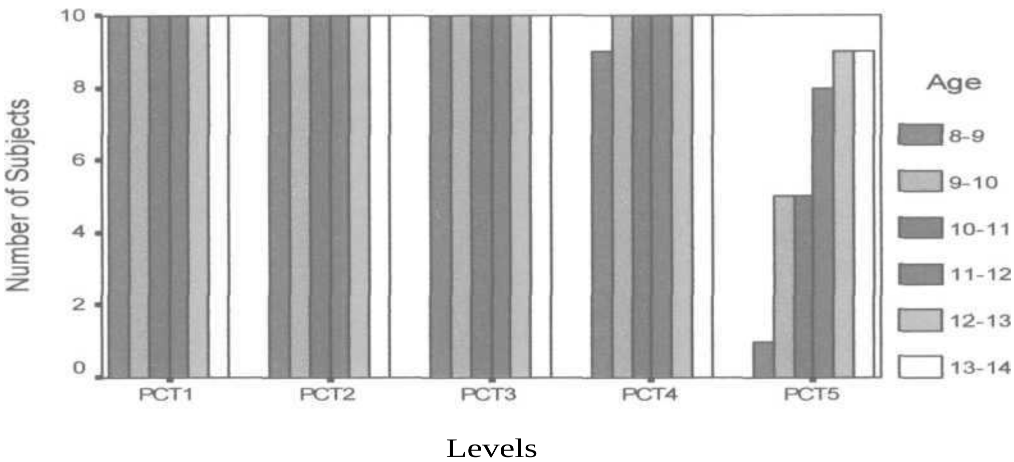


Levels

Graph 10: Performance of normal children on the Alternate Sequence Task.

The graph above shows the developmental trend and it can be seen that all the children were able to accomplish the first four levels. There is a difference observed across different age groups at the fourth level of this test (AST 4). Further, as the complexity increased, only the 13-14 year old subjects were able to meet the 50% criteria on the last level AST 5.

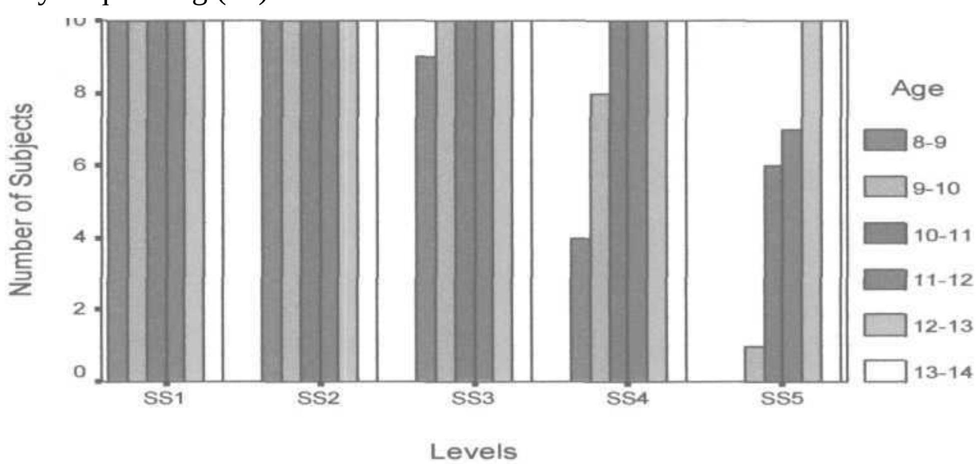
2. Picture Counting Task (PCT)



Graph 11: Performance of normal children on the Picture Counting Task.

The results of the Picture Counting Task reveal that as the age increased there was an enhancement in the ability to recall the pictures. In addition, it was also found from the results that there is not much of a difference in the performance of the different groups till the fourth level. The last level (PCT 5) was achieved by all the age groups except 8-9 year olds. The older children show better recall which might be due to better semantic associations made as a function of language development.

3. Story Sequencing (SS)



Graph 12: Performance of normal children on the Story Sequencing Task.

The graph above indicates that the ability to retain the story and to arrange the sequence improves as the child grows older. The performance of the younger children worsened as the length of the story increased. Subjects from the 8-9 year old age group could perform upto the third (SS 3) level. The last level was achieved by children in the age group of 10-11 years and above.

Based on these above results it can be suggested that an increase in chronological age is accompanied by a systematic increase in memory span. Another finding from this study is that the digit span improved with an increment in age. The number of items recalled by children improved from 6 to 9 units as a function of age with minimum units recalled being 6 units by 8-9 year olds and 9 units by 13-14 year olds. This is in concurrence with Miller's (1956) study which reported that the average score for a 4 year old is about 4 items, whereas for a 9 year old it is 6 items and 7 or higher items for children above 12 years.

It has been established by researchers that there appears to be a developmental pattern in the rehearsal strategies used by children. It was seen in the present study that the younger children were able to recall only 6 units and the recall span deteriorated with an increase in the number of units. It was also noticed that as the age increased, the children performed better. Ornstein, Naus & Liberty (1975) have established that as children grow older, there appears to be an enhancement in the recall strategies used by them. The younger subjects tend to recall the item presented recently (Primacy effect) and the older subjects tend to use cumulative rehearsal strategies such as subvocal rehearsal, chunking, mnemonics etc. which in turn results in integrated units and a better recall. This could be a possible explanation for the better performance of older children in recalling larger items in the present study. Also in the lower levels of picture and word recall tasks the children recalled all the items which were arranged categorically. This might have aided in easier recall due to the dense connections between words of a particular category.

The results also highlight the interrelationship between attention and memory. The higher level tasks involve the role of attention to recall the longer strings of digits or words and thus the development of attention also parallels the development of memory. Hence, the cognitive skills are interdependent on one another.

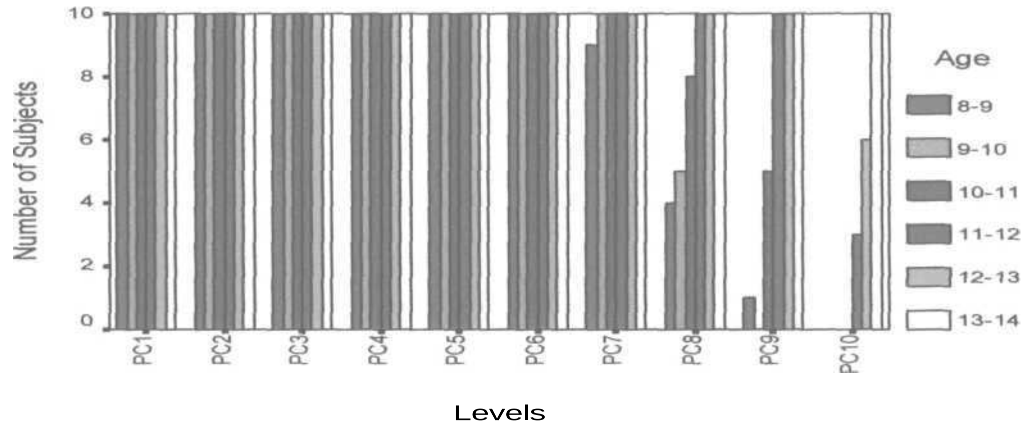
Therefore, in the present study it was found that as the number of items increased, the younger child's recall span reduced suggesting that the longer string of words or digits are recalled only at higher ages. Based on this it can be suggested that the recall of complex sentences involves the increased storage and quicker retrieval abilities. Thus it can be suggested that memory plays an important role in language development and thus improving the cognitive abilities would further enhance language development.

PROBLEM SOLVING

The performance of the normal subjects from all the six age groups in the different tasks used to assess problem solving is graphically represented below.

I. AUDITORY MODE

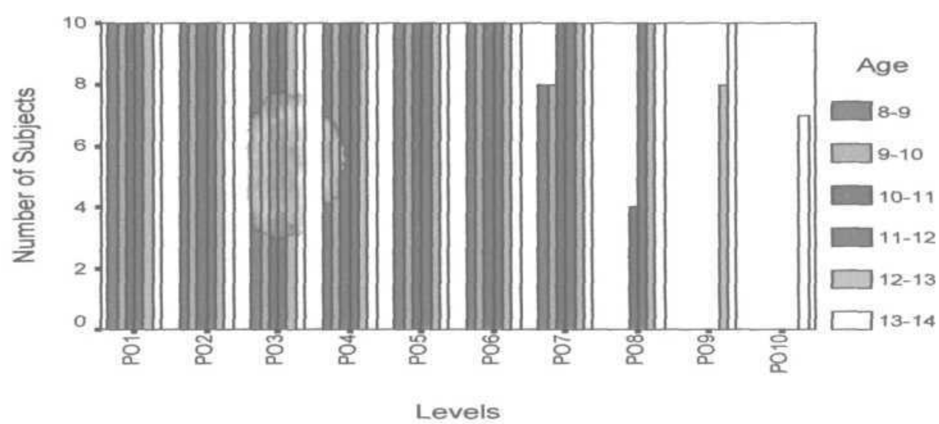
1. Predicting Cause (PC)



Graph 13: Performance of normal children on the task of Predicting Cause.

Predicting the cause involved the child to think logically and creatively so as to give an appropriate cause for a situation given by the clinician. Not all the items were achieved by all the age groups. The higher level situations were difficult for the younger group to predict. Till the seventh level (PC 7) all the age groups were able to predict the cause and after this level there is deterioration in performance across age groups. As seen in the graph, the highest level (PC 10) could be achieved by only the oldest subjects i.e. 12-13 and 13-14 years.

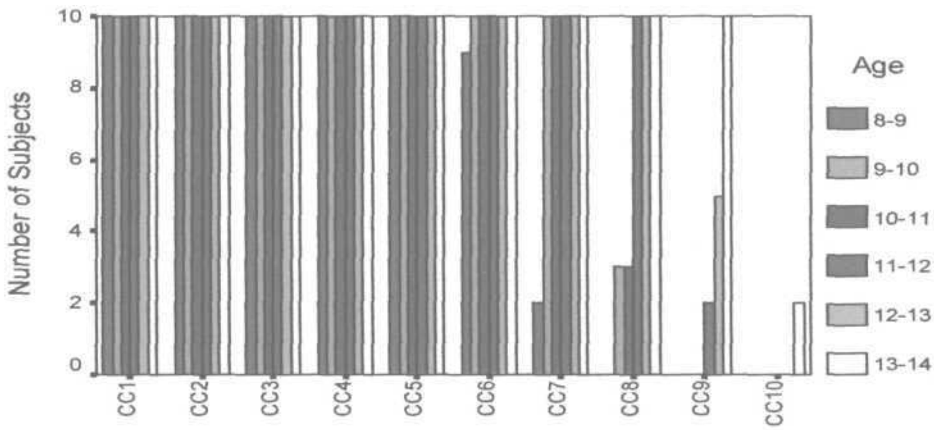
2. Predicting Outcome (PO)



Graph 14: Performance of normal children on the task of Predicting Outcome.

Similar to the previous task, this task also involved logical and creative thinking on the child's part. In this task too the younger group found it difficult to predict the outcome at higher levels especially the last three levels (PO 8, PO 9, and PO 10). The last two levels (PO 9, PO 10) could be achieved by only the oldest subjects i.e. 12-13 and 13-14 year olds.

3. **Compare and Contrast** (CC)



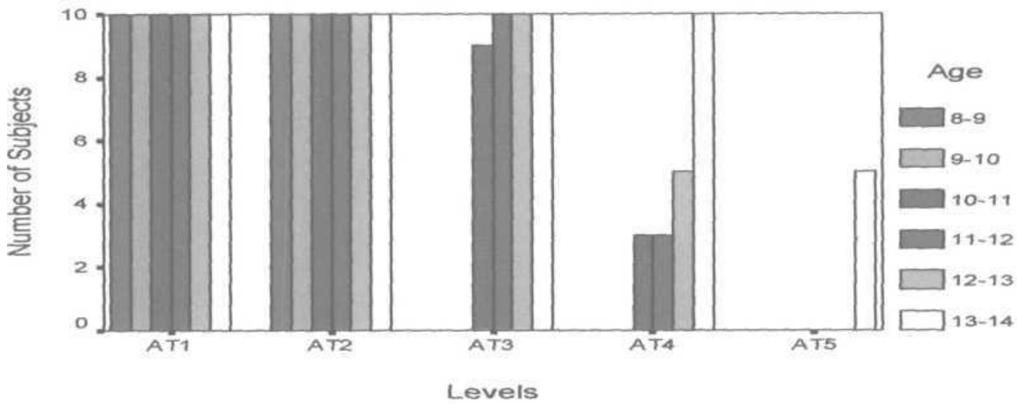
Levels

Graph 15: Performance of normal children on the Compare and Contrast task.

The results of this task also revealed that as the age increases, the problem solving abilities improve as a function of age. As the complexity of items involved increased, the subjects performed poorly. Only the children from 12-13 and 13-14 years age group were able to compare and contrast the nine items of the list. On the other hand, the other age groups did not respond to all the items. This indicates that problem solving abilities increase as a function of age.

II. VISUAL MODE

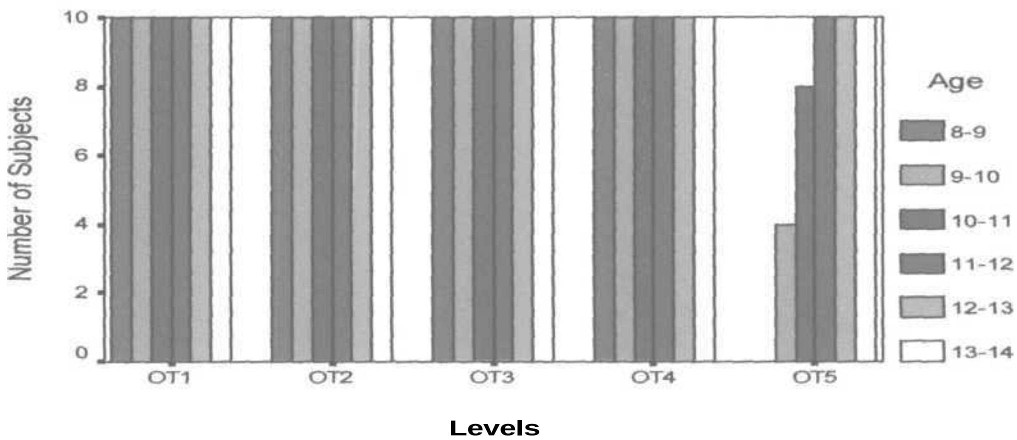
1. Association Task (AT)



Graph 16: Performance of normal children on the Association task.

The results of the Association task reveal that the ability to associate the visually presented stimuli improves as the age increases. As the age increased there was an enhancement in the ability to associate more than two pictures from a picture array till level III. The older age groups could associate the pictures of level IV, unlike younger groups. But the last level could be achieved only by 13-14 year old subjects. Although only a few subjects from 13-14 age group could perform on AT 5, they met the 50% criteria.

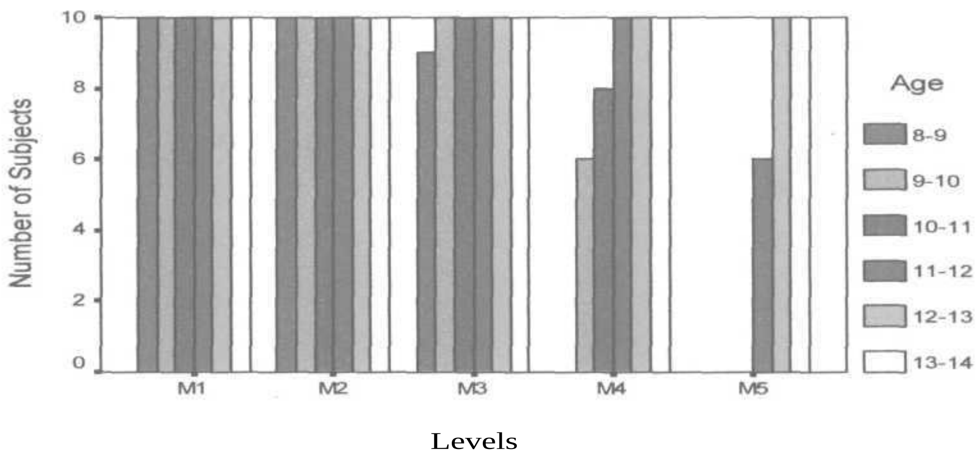
2. Overlapping Test (OT)



Graph 17: Performance of normal children on the Overlapping Test.

The results of the graph above indicate that all the age groups were able to visually identify the overlapping stimuli for the first four levels. However since the complexity of the overlap was highest in the last level (OT 5), 8-9 years and 9-10 year old subjects were unable to achieve this level. This indicates that the ability to visually solve the problem improves as the child gets older.

3. Mazes (M)



Graph 18: Performance of normal children on the Mazes task.

As is evident from the graph, the children from 8-9 age group were able to perform well till level III of the task. In contrast the older children were able to perform till level V. The younger subjects were not able to attain the higher levels involving higher problem solving skills. Only children of 12-13 and 13-14 years age group were able to meet 100% criteria on the last level M 5.

The results of this domain reveal that the problem solving abilities involving reasoning, thinking etc. are attained as the child grows older. The environment in which the child has grown up also plays an important role in the acquisition of these skills. It is well established that these problem solving abilities also aid in language development. This would also result in better scholastic performance, which is the main domain in which children with learning disabilities are deficient.

Solving a complex problem involves both retrieval of information from long term memory as well as processing and maintenance of current information in short term memory. Thus, the reduced problem solving abilities in younger children may be attributed to the other cognitive domains such as attention and memory, on which it is contingent. This shows that the development of problem solving abilities also parallels the development of memory.

A child with increased knowledge can have multiple advantages in problem solving. The more knowledgeable child might know a better way to represent the problem information, have information which helps in identifying critical problem features and in constructing solution plans. Increased knowledge leads to more organized solution attempts, one consequence of which is a reduced load on STM during problem solving. In effect, relevant factual knowledge can change a task from one requiring an extended sequence of operations to one which can be solved simply by retrieving the answer from LTM.

Thus it is evident that the different problem solving strategies of the children such as hypothesis-testing, reasoning, creative thinking, concept organization develop as a function of age which has also been reported by Bruner et al, (1966). This may be the possible explanation for the older children using more of creative and refined language since their problem solving abilities are superior to the younger age group.

Comparison between normal children and children with learning disabilities

I. Attention

The table below shows the Mean and Standard Deviations of the Normal children and Children with LD in the domain of Attention. The mean values indicate that normally developing children have outperformed the children with LD on all the tasks.

Table - 1: Mean and Standard Deviations of the normal children and children with LD

Age Group	Group			
	Normals		LDs	
	Mean	Std. Deviation	Mean	Std. Deviation
8-9	39.0000	2.4495	29.0000	2.4495
9-10	45.2000	2.1499	33.2500	1.7078
10-11	47.0000	.8165	34.7500	1.7078
11-12	48.9000	.7379	36.5000	1.7321
12-13	49.2000	.7888	38.5000	3.4157
13-14	49.7000	.4830	41.0000	1.4142

Mann-Whitney U test was performed to see the differences between normal children and children with LD, within each age group.

The table below shows the \Z\ values for the different age groups in the domain of Attention.

Table - 2: |Z| values across age groups

Age Group	|Z|
8-- 9 years	2.899 **
9 - 10 years	2.838 **
10-- 11 years	2.886 **
11-- 12 years	2.913 **
12-- 13 years	2.896 **
13-- 14 years	3.040 **

** Significant at 0.01 level.

From the |Z| values in the table above it can be seen that there is significant difference between normal children and children with learning disabilities in all the age groups in the domain of Attention.

II. **Memory**

The table below shows the Mean and Standard Deviations of the Normal children and children with LD in the domain of Memory. The mean values indicate that normally developing children have outperformed the children with LD on all the tasks.

Table - 3: Mean and Standard Deviations of the normal children and children with LD

Age Group	Group			
	Normals		LDs	
	Mean	Std. Deviation	Mean	Std. Deviation
8-9	29.4500	1.7865	18.1250	5.4829
9-10	34.5500	1.2349	23.7500	1.3229
10-11	37.1000	1.3703	25.0000	3.0277
11-12	40.6000	1.2202	29.5000	2.2730
12-13	41.6500	.7835	31.3750	4.1307
13-14	43.5500	1.0659	33.5000	1.6833

Mann-Whitney U test was performed to see the differences between normal children and children with LD, within each age group.

The table below shows the |Z| values for the different age groups in the domain of Memory.

Table - 4: |Z| values across age groups

Age Group	|Z|
8-9 years	2.844 **
9-10 years	2.896 **
10-11 years	2.844 **
11-12 years	2.841 **
12 - 13 years	2.866 **
13-14 years	2.841 **

** Significant at 0.01 level.

From the |Z| values in the table above it is evident that there is a significant difference between the mean scores of the normal children and children with LD in all the age groups in the domain of Memory.

III. Problem Solving

The table below shows the Mean and Standard Deviations of the normal children and children with LD in the domain of Problem Solving. The normally developing children have outperformed the children with LD on all the tasks similar to the other two domains.

Table - 5: Mean and Standard Deviations of the normal children and children with LD

Age Group	Group			
	Normals		LDs	
	Mean	Std. Deviation	Mean	Std. Deviation
8-9	65.7000	1.7670	48.5000	8.6987
9-10	70.8000	1.9322	58.5000	1.0000
10-11	75.8500	2.7188	63.0000	4.5461
11-12	84.2000	2.4404	69.5000	4.2032
12-13	88.8000	2.0976	73.5000	6.1373
13-14	95.0500	.9560	76.5000	4.5092

Mann-Whitney U test was performed to see the differences between normal children and children with LD, within each age group.

The table below shows the |Z| values for the different age groups in the domain of Problem Solving.

Table - 6: |Z| values across age groups

Age Group	|Z|
8-9 years	2.850 **
9-10 years	2.863 **
10-11 years	2.835 **
11-12 years	2.838 **
12 - 13 years	2.838**
13-14 years	2.876 **

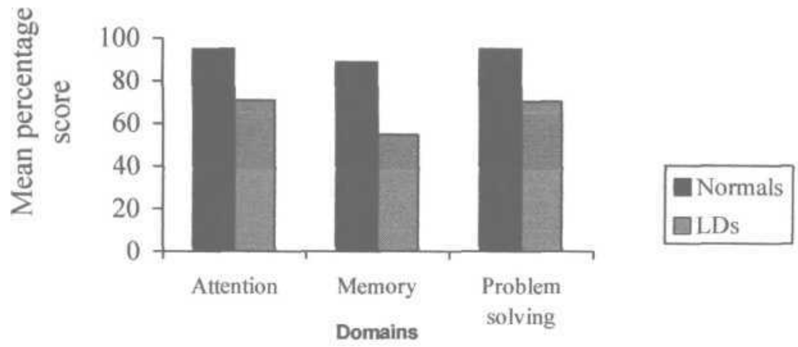
** Significant at 0.01 level.

From the |Z| values in the table above it is evident that there is a significant difference between the mean scores of the normal children and children with LD in all the age groups in the domain of Problem Solving.

From the Mann-Whitney U test it can be seen that the difference between the normal children and children with LD follows a similar trend across all the age groups and across domains, with the scores being approximate to each other. Only in the 13-14 age group, the difference was higher in the domain of Attention, as can be inferred from the higher score compared to the other scores.

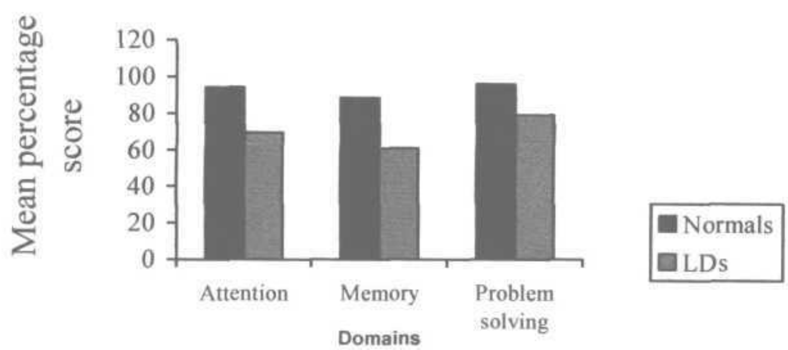
Graphical representation of performance of normal children and children with learning disabilities

The scores of the normally developing children and children with LD were computed in percentage and the performance of the two groups in the three different domains i.e. Attention, Memory, and Problem Solving for each age group is graphically represented below:



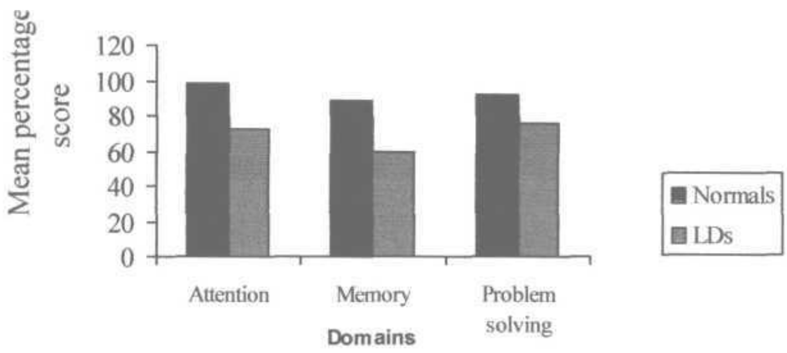
Graph 19: Percentage scores of subjects from the 8-9 age group in each of the cognitive domains.

As is evident from the graph, in the domain *of Attention,* normal children achieved 95% score, whereas the score of the children with LD was 70%, with normal children outperforming the children with LD by about 25%. In the domain of *Memory,* the scores were a little lower compared to that of Attention. Normal children achieved a mean of 90% and the clinical population achieved about 50%, with the difference being as much as 40%. In the third domain i.e. *Problem Solving,* the scores were similar to that of Attention domain. The score of normal children was 95% and that of children with LD was 70% with the difference being 25%.



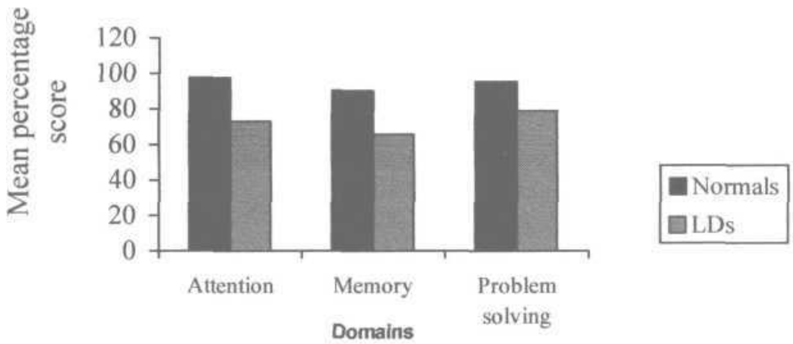
Graph 20: Percentage scores of subjects from the 9-10 age group in each of the cognitive domains.

As observed in the above graph, in the first domain i.e. Attention, the mean score of normal children was 95% and that of the children with LD was about 70% and the difference was 25%. In the domain of Memory, the scores of the two groups were 90% and about 60% with the difference being 30%. As observed, the difference in the domain of Memory is 10% lesser in the 9-10 years age group, compared to the 8-9 years age group. In the domain of Problem Solving, the score of normal children was 95% and that of children with LD was 80% with the difference being 15%, which is 10% lesser than the 8-9 years age group.



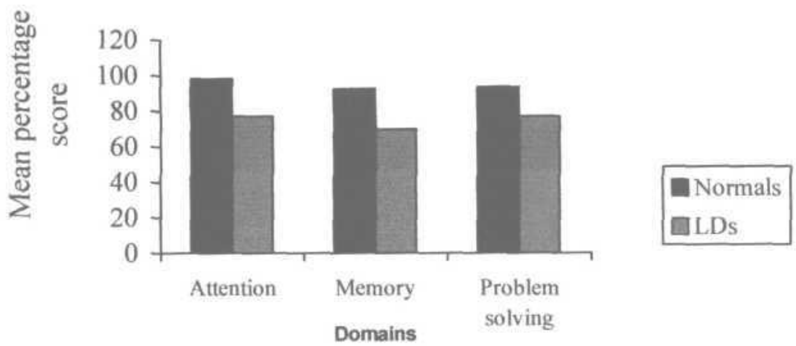
Graph 21: Percentage scores of subjects from the 10-11 age group in each of the cognitive domains.

As shown in the graph, the mean score of normal children in the domain of Attention is slightly higher than the previous age group. The normal children had a mean score of 98% as opposed to the mean score of the clinical group which remained constant at 70%, and the difference was 28%. In the domain of Memory, the score of the normal children was about 90% and that of the children with LD being 58% with the difference being 32%. This was almost similar to the scores of the 9-10 age group. In the domain of Problem Solving, the score of normal children was 91% and that of children with LD was 76% with the difference being 15%, which is the same as that for the 9-10 years age group.



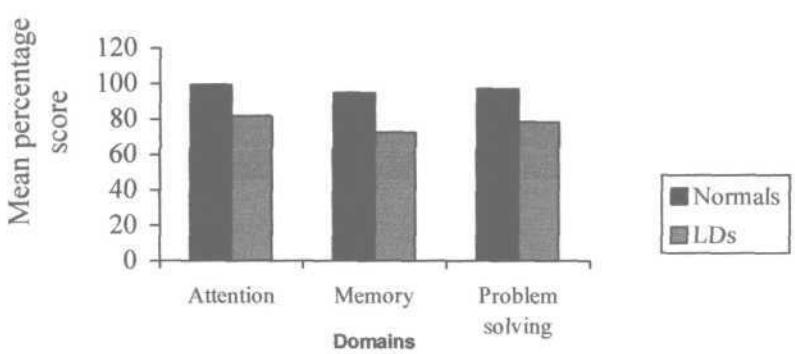
Graph 22: Percentage scores of subjects from the 11-12 age group in each of the cognitive domains.

As depicted in the graph above, the mean score of normal children in the domain of Attention is 98% and that of the children with LD is 73%. Thus, the difference between the two groups is 25%. In the second domain i.e. Memory, the score of the normal children is about 90% and that of the children with LD is 65%, with the difference being 25%. It can be observed that there is an improvement in the mean score of the clinical population, in the domain of Memory. In the third domain i.e. Problem Solving, the score of normal children is 96% and that of children with LD is 80% with the difference being 16%. The scores of this third domain are not significantly different from the previous age group.



Graph 23: Percentage scores of subjects from the 12-13 age group in each of the cognitive domains.

As illustrated in the graph above, the mean score of normal children in the domain of Attention is 98% and that of the children with LD is 77%, with the difference being 21%. It is evident that the mean score of the clinical population is higher than the previous age group i.e. 11-12 years. In the domain of Memory, the score of the normal children is 90% and that of the children with LD is 70%, with the difference being 20%. This gradual reduction in the difference shows an upward developmental trend especially in the domain of Memory. In the third domain i.e. Problem Solving, the score of normal children is 94% and that of children with LD is 77% with the difference being 17%.



Graph 24: Percentage scores of subjects from the 13-14 age group in each of the cognitive domains.

As depicted in the graph above, the mean score of normal children in the domain of Attention has reached the ceiling with 99% and that of the children with LD is 82%, with the difference being 17%. The mean score of the clinical group has improved, thereby reducing the difference between the two groups. In the domain of Memory, the score of the normal children is 95% and that of the children with LD is 73%, with the difference being 22%. As shown, the scores of both the groups have increased in the domain of Memory. In the domain of *Problem Solving* too the normal children have reached close to the ceiling with 97%, and the score of children with LD is 80% with the difference being 17%. The percentage score of both the groups have increased by about 3% compared to the 12-13 age group.

The results of this study indicate that there is a developmental pattern in the cognitive-linguistic processes such as, attention, memory and problem solving. In essence, the child acquires the different cognitive-linguistic skills with advancement in age. These cognitive-linguistic skills also aid in language acquisition. Piaget (1969) in his model explains the intricate relationship between cognition, language, and intellectual development. He explains that the growing child passes from stage to stage during development, with each stage characterized by different set of cognitive processes and cognitive development was said to consist of different periods, each with a distinctive mental structure. Hence there appears to be a refinement in the linguistic skills as the child grows older which is contingent on the cognitive-linguistic abilities of the child.

The graphs numbered 19-24 show the developmental patterns of the cognitive-linguistic skills in normal children and children with LD. As depicted in the graphs there is a large difference between the two groups, with normal children outperforming the children with LD by a huge margin. This is concurrent with various cognitive and neuropsychological studies in literature which have documented the cognitive deficiencies of children with LD.

Several authors like Douglas (1983), Obrzut et al. (1981), Tarnowski et al, (1986) have reported that children with LD differ from children without learning problems in their ability to select or allocate the processing ability, that is, to sustain attention. Ross (1976) suggested Learning disability to be a developmental lag in selective attention, that is, the ability to use and sustain attention. Deficits in attention were found at the levels of alertness, stimulus selection, and/or vigilance. Dykman et al. (1971) concluded that attention and physiologic deficits in children with LD changed as a function of maturation and experience. This is in lieu with the findings of the present study, which show that the selective and sustained attentional abilities of these children improve as a function of age.

Thus, while studies suggest that children with LD are deficient in selective attention, they do not tell us whether or not a selective attention deficit is responsible for the learning problems. To do this, they have to establish that a relationship exists between performance on selective attention tests and measures of either the type of or severity of LDs, which is beyond the purview of the present study. This aspect needs to be researched upon, though.

It can also be noted from the graphs numbered 19-24 that the LD group clearly follows a developmental pattern with the scores gradually increasing with age. This is especially evident in the domain of Memory wherein the difference in concept organization have been found to be deficient. Children with learning disabilities solved significantly fewer problems than those in-the normal group. Children in the third grade solved significantly fewer problems than those in the eighth grade. These developmental findings were similar to those obtained with children without learning problems but there is a developmental lag in the problem solving abilities of children with LD.

Problem solving involves a variety of cognitive processes and the importance of any process varies from one problem to another. Thus, the deficits in the problem solving abilities in children with LD may be attributed to the deficits in the other cognitive domains such as attention and memory, on which it is contingent. Solving a complex problem involves both retrieval of information from long-term memory as well as processing and maintenance of current information in short term memory. Since, some of the problems required the retrieval of information from long-term memory, failure might have occurred because retrieval was not effective. Failure in problem solving might also have occurred because the child could not only hold information in short term memory and operate on it, due to its limited capacity.

Children with learning disabilities also tested significantly fewer hypotheses and were less consistent following feedback than were children without learning problems. This type of responding was similar to that observed with younger children without learning problems and was interpreted as reflecting basic problems in selective attention.

The results of the present study indicate that the different cognitive processes are contingent upon one another for effective cognitive-linguistic functioning and both the normal children and children with LD follow a developmental pattern in the acquisition of various cognitive-linguistic skills, with the latter group showing a developmental lag. The protocol developed in this study highlights the need for a detailed assessment of the cognitive-linguistic functioning in children with LD and would be helpful in assessing the cognitive-linguistic domains. The obtained results of the present study would be also useful in comparing the cognitive-linguistic abilities in this clinical population with respect to age. The clinicians can determine the level of cognitive functioning in the children with LD. In this perspective, the present study helps the Speech Language Pathologist in framing appropriate goals for the intervention of children with cognitive-linguistic impairments.

SUMMARY AND CONCLUSION

It is very important for a Speech Language Pathologist to understand the relationship between cognition and language and to be knowledgeable about the developmental pattern of the cognitive-linguistic skills in normally developing children and in children with language impairments. Assessment of the cognitive-linguistic abilities is very important to identify these deficits and to plan for intervention.

There are a few tests which have been developed in the Western context to assess the cognitive-linguistic skills in children with the norms being restricted to the Western population. Most of these tests focus on one or a few of the cognitive-linguistic domains. Cognitive-linguistic skills in children have not been widely explored in the Indian context. In particular, there are very few studies on the cognitive-linguistic skills in the disordered population in Indian context. There have been no studies of children with cognitive-linguistic impairment as seen with LD.

The present study aimed to:

- Develop a cognitive-linguistic assessment protocol for children with learning disabilities
- Study the deficit areas/domains in children with learning disabilities which will aid in the assessment
- Identification of cognitive-linguistic domains in which these children are deficient, allowing for intervention based on a developmental schedule.

The present study was carried out in five phases. The first phase included developing the protocol, and the cognitive processes employed most often in linguistic communication tasks were considered. The protocol was developed considering the Cognitive Linguistic Assessment Protocol for Children (CLAP-C) by Anuroopa (2006) as the base, with suitable modifications with the help of a Clinical Psychologist in order to suit the population and age under consideration, of this study. The protocol developed, consisted of three different domains i.e. Attention, Memory and Problem Solving. Each domain consisted of different tasks, and the set of items of each task were arranged in a hierarchy from simple to complex, from first to the fifth level. Each domain was assessed both in the auditory and visual modalities. Scoring was done appropriately.

In the second phase, after the development of the protocol, a pilot study was carried out in which the protocol was administered on 12 normal Kannada speaking children in the age range of 8 - 14 years. In the third phase, suitable modifications were made based on the pilot study, in order to suit the population. In the fourth phase the protocol was administered on 60 normal children in the age range of 8 - 14 years who had Kannada as their mother tongue and the pattern of cognitive-linguistic abilities in these children were studied. Mastery of a level of each task was determined based on 50% criteria. In the fifth and final phase, the protocol was administered on 24 children with learning disabilities after suitable modifications were made in order to suit the population under consideration.

The data obtained was tabulated appropriately and was subjected to qualitative and quantitative analysis. Statistical analysis was carried out with the help of SPSS (Version 13.0) statistical package. A descriptive analysis of the performance of all the subjects in each domain across age groups was done, to compare the scores of normal children and children with LD. Mann-Whitney U test was performed to see the differences between normal children and children with LD, within each age group. Graphs were drawn which showed the emergence of cognitive-linguistic abilities in normally developing children. In addition, the performance of the normal vs. clinical groups in different domains for each age group was also graphically represented.

Conclusions

The results of the present study indicate that there is a significant difference between the scores of the normal children and children with LD in all the age groups in the domains of Attention, Memory and Problem Solving. The results also reveal that there is a developmental pattern in the cognitive-linguistic processes such as, attention, memory and problem solving i.e. the child acquires the different cognitive-linguistic skills with advancement in age. The LD group also clearly followed a developmental pattern with the scores gradually increasing with age. This was especially evident in the domain of Memory wherein the difference between the two groups was larger compared to the other two domains i.e. Attention and Problem Solving. Short-term and long-term memory problems in children with LD are associated with the way in which information is strategically processed and the way in which information is mentally represented.

The protocol developed in this study would be helpful in assessing the cognitive-linguistic domains in children with LD. The obtained results of the present study would be also useful in comparing the cognitive-lingustic abilities in this clinical population with respect to age. The clinicians can determine the level of cognitive functioning in the children with LD. The results of this study with respect to the acquisition of cognitive-linguistic skills would be helpful in assessing the cognitive disabilities in other language disorders. In this perspective, the present study helps the Speech Language Pathologist in framing appropriate goals for the intervention of children with cognitive-linguistic impairments. This protocol provides the clinician with a conceptual framework of hierarchically arranged tasks that enables selection of appropriate treatment tasks for specific areas of client function and deficit.

Suggestions for further research

- Normative studies on regional, cultural and socioeconomic variations may be compared in future
- Standardization and comparison across different clinical populations may be taken up
- The relationship between cognitive-linguistic skills and measures of the type of LD and/or severity of LD can be studied
- Comparison of cognitive-linguistic skills across other variables such as gender may be studied in children with LD.

BIBLIOGRAPHY

American Speech Language Hearing Association (1987). *In* Boyle, M. & Strikowsky-Harvey, S. (1999). Cognitive communicative disorders of right cerebrovascular accident patients and reimbursement for treatment. *Seminars in Speech and Language, 20(4),* 335-341.

Annett, M. (1959). The classification of instances of your common class concepts by children and adults. *British Journal of Educational Psychology, 29,* 223-236.

Anuroopa (2006). Development of cognitive linguistic assessment protocol for children (CLAP-C). Unpublished Master's Dissertation, University of Mysore.

Baddeley, A. (1986). *Working memory*. Oxford: Clarendon Press.

Baker, J.G., Ceci, SJ. & Hermann, N.D. (1987). Semantic structure and processing: Implications for the learning disabled child. *In* Swanson, H.L. (Ed.), *Memory and Learning Disabilities.* Greenwich, CT: JAI Press.

Barkley, R.A. (1990). *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment.* New York: Guilford Press.

Bauer, R.H. (1979). Memory processes in children with learning disabilities: Evidence for a deficient rehearsal. *Journal of Experimental Child Psychology, 24,* 415-430.

Bayley, N. (1969). *Bayley Infant Scales of Development.* New York: Psychological Corporation.

Best, J.B. (1999). *Cognitive Psychology,* 5th Edn. Pp 15-17. Belmont: Wadsworth Publishing Company.

Binet, A., & Simon, T. (1905). Standardized tests of intelligence or scholastic aptitude. *In* Thorndike, R.L. & Hagen, E.P. (Eds.), *Measurement and Evaluation in Psychology and Education* (pp. 296-350). New Delhi: Wiley Eastern Limited.

Boliek, C.A., Obrzut, J.E. & Shaw, D. (1988). The effects of hemispatial and asymmetrically focused attention on dichotic listening with normal and learning disabled children. *Neuropsychologia, 26,* 417-433.

Bruner, J. S., Goodnow, J., & Austin, C. A. (1956). *A study of thinking*. New York: Wiley.

Bruner, J. S., Olver, K. R., & Greenfield, P. M. (1966). *Studies in cognitive growth.* New York: Wiley.

Cantwell, D.P. & Baker, L. (1985). Psychiatric and learning disorders in children with speech and language disorders: A descriptive analysis. *Advances in Learning & Behavioral Disabilities, 4,* 29-47.

Ceci, S.J., Lea, S. & Ringstrom, M. (1980). Coding processes in normal and learning disabled children: Evidence for modality-specific pathway to the cognitive system. *Journal of Experimental Psychology: Human Learning and Memory, 6,* 785-795.

Chapey, R. (2001). *Language intervention strategies in aphasia and related neurogenic communication disorders.* New York: Lippincott, Williams, & Wilkins.

Chee, P., Logan, G., Schachar, R., Lindsay, P., & Wachsmuth, R. (1989). Effects of event rate and display time on sustained attention in hyperactive, normal, and control children. *Journal of Abnormal Child Psychology, 17,* 371-391.

Clements, S. D. (1966). *Minimal brain dysfunction in children: Terminology and identification.* PHS Publication 1415, U. S. Department of Health, Education and Welfare.

Cohen, R. (1982). Individual differences in short-term memory. *International Review of Research in Mental Retardation, 11, 43-11.*

Craik, F.I.M. & Tulving, E. (1975). Depth of processing and the retention of words in episodic memory. *Journal of Experimental Psychology, 104,* 268-294.

Darwin, C.J., Turvey, M.T. & Crowder, R.G. (1972). An auditory analogue of the Sperling partial report procedure. *Cognitive Psychology, 3,* 255-267.

Diagnostic and Statistics Manual of Mental Disorders. (DSM-IIIl), 3rd ed). (1980). Washington D. C: American Psychiatric Association. New York: Syracuse University Press, 1966.

Douglas, V.I. (1983). Attention and cognitive problems. *In* Rutter, M. (Ed.), *Developmental neuropsychiatry* (pp. 280-329). New York: Guilford Press.

Douglas, V.I. (1988). Cognitive deficits in children with attention deficit disorder with hyperactivity. *In* Bloomingdale, L.M. & Sergeant, J. (Eds.), *Attention deficit disorder: Criteria, cognition, intervention.* A book supplement of the Journal of Child Psychology and Psychiatry (No. 5). New York: Pergamon Press.

Douglas, V.I. & Peters, K.B. (1978). Toward a clear definition of the attentional deficit of hyperactive children. *In* Hale, G.A. & Lewis, M. (Eds.), *Attention & the development of cognitive skills* (pp. 173-248). New York: Plenum.

Dykman, R., Ackerman, P., Clements, S. & Peters, J. (1971). Specific learning disabilities: At attentional deficit syndrome. *In* "Progress in Learning Disabilities," Vol. 2 (H. Myklebust, ed.) (pp. 56-93). New York: Grune & Stratton.

Elbert, J.C. (1984). Short-term memory encoding and memory search in the word recognition of learning disabled children. *Journal of Learning Disabilities,* 77,342-345.

Felton, R.H. & Wood, F.B. (1989). Cognitive deficits in reading disability and attention deficit disorder. *Journal of Learning Disabilities*, *22,* 3-13.

Freibergs, V. & Douglass, J.I. (1969). Concept learning in hyperactive and normal children. *Journal of Abnormal Psychology, 74,* 388-395.

Gaddes, W.H. (1994). Attention Deficit Disorder. *In* Gaddes, W.H. & Edgell, D. (Eds.), *Learning disabilities and brain function: A neuropsychological approach* (pp. 253-303). New York: Springer-Verlag.

Gesell, A. & Amatruda, C.S. (1949). *Gesell Developmental Schedules*. New York: Psychological Corporation.

Gholson, B., Levine, M. & Phillips, S. (1972). Hypothesis strategies and stereotypes in discrimination learning. *Journal of Experimental Child Psychology*, *13,* 423-446.

Gibson, E.J. (1969). *Principles of Perceptual Learning and Development.* New York: Appleton Century-Crofts.

Goldstein, S. & Goldstein, M. (1990). *Managing attention disorders in children.* New York: J. Wiley & Sons.

Greeno, J.G. (1973). The structure of memory and the process of solving problems. In *Contemporary issues in Cognitive Psychology,* R. L. Solso (Ed.). Washington, D. C: V. H. Winston & Sons.

Hagen, J. (1967). The effect of distraction on selective attention. *Child Development*, *38,* 685-694.

Hagen, J.W. & Kail, R.V. (1975). The Role of Attention in Perceptual and Cognitive Development. In W. Cruickshank and D. P. Hallahan (Eds.), *Perceptual and Learning Disabilities in Children* (Vol. II). Syracuse, N. Y.: Syracuse University Press.

Hammill, D.D. (1993). A timely definition of learning disabilities *Family Community Health*, *16(3)*, 1-8.

Hammill, D.D., Leigh, J.E., McNutt, G. & Larsen, S.C. (1987). New definition of learning disabilities. *Journal of Learning Disabilities, 20(2),* 109-113.

Hanson, R.A. & Montgomery, J.W. (2002). Effects of general processing capacity and sustained selective attention on temporal processing performance of children with specific language impairment. *Applied Psycholinguistics, 23,* 75-93.

Harris, P.L. (1989). *Children and emotion: The development of psychological understanding.* Oxford, England: Blackwell.

Hayes, J.R. (1978). *Cognitive Psychology.* Homewood, IL: Dorsey Press.

Hebb, D. O. (1949). Attention Deficit Disorder. *In* Gaddes, W.H. & Edgell, D. (Eds.), *Learning disabilities and brain function: A neuropsychological approach* (pp. 253-303). New York: Springer-Verlag.

Hernandez-Peon, R. (1964). Psychiatric implications of neuropsychological research. *Bulletin of the Menninger Clinic, 28,* 165-185.

Hogg, C, Callias, M.R. & Pellegrini, D. (1986). Treatment of a 7-year-old hyperactive boy with educational problems. *Behavioral Psychotherapy, 14(2),* 145-161.

Hoskins, B.B. (1979). *A study of hypothesis testing behavior in language disordered children.* Unpublished Doctoral Dissertation, Northwestern University.

James, W. (1890). *The principles of psychology.* New York: Henry Holt & Co.

Johnson, D.J., & Myklebust, H.R. (1967). *Learning disabilities: Educational principles and practices.* New York: Grune & Stratton.

Jorm, A.F. (1983). Specific reading retardation and working memory: A review. *British Journal of Psychology, 74,* 311-342.

Kail, R. & Hagen, J.W. (1982). Memory in childhood. *In* Wolman, B.B. (Ed.), *Handbook of Developmental Psychology* (pp. 350-366). New Jersey: Prentice-Hall, Inc.

Karrer, R., Nelson, M. & Galbraith, G.C. (1979). Psychophysiological research with the mentally retarded. *In* N. R. Ellis (ed.), *Handbook of mental deficiency, psychological theory, and research* (pp. 231-288). Hillsdale, N.J.: L. Erlbaum Associates.

Kaufman, A.S. & Kaufman, N.L. (1983a). *K-ABC administration and scoring manual.* Circle Pines, MN: American Guidance Service.

Kaufman, A.S. & Kaufman, N.L. (1983b). *K-ABC interpretive manual.* Circle Pines, MN: American Guidance Service.

Keogh, B.K. (1971). Hyperactivity and Learning Disorders: Review and Speculation. *Exceptional Children, 38,* 101-110.

Keogh, B.K. & Margolis, J. (1976). Learn to Labor and to Wait: Attentional Problems of Children with Learning Disorders. *Journal of Learning Disabilities,* 9(5), 276-286.

Lambert, N. & Sandoval, J. (1980). The prevalence of learning disabilities in a sample of children considered hyperactive. *Journal of Abnormal Child Psychology, 8,* 33-50.

Mattick, I. & Murphy, L.B. (1979). Cognitive Assessment. *In* Adamson, W.C. & Adamson, K.K. (Eds.), *A Handbook for Specific Learning Disabilities* (pp. 63- 105). New York: Gardener Press.

McCarthy, D. (1972). *Manual for the McCarthy Scales of Children's Abilities.* New York: Psychological Corporation.

McNamara, J.K. & Wong, B.Y.L. (2003). Memory for Everyday Information in Students with Learning Disabilities. *Journal of Learning Disabilities, 36(5),* 394-406.

Metcalfe, J. & Wiebe, D. (1987). Intuition in insight and non-insight problem solving. *Memory and Cognition, 15,* 238-246.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for information processing. *Psychological Review, 63,* 81-87.

Mundy & Peter, (1997). On the nature of communication and language impairment in autism. *Mental Retardation and Developmental Disabilities Research Reviews, 3(4),* 343-349.

National Conference on Learning Disabilities (1987). *In* J. F. Kavanagh and Tom J. Truss, eds. "Proceedings of the National Conference on Learning Disabilities." Yorkton Press, Parkton, Maryland.

National Joint Committee on Learning Disabilities (1987). A position paper. *Journal of Learning Disabilities, 02(2),* 107-108.

Neisser, U. (1976). *Cognition and reality.* San Francisco: W. H. Freeman.

Neisser, U. (1997). *Cognitive Psychology.* Englewood Cliffs, NJ: Prentice Hall.

Norman, D.A. & Bobrow, D. G. (1975). On data-limited and resource-limited processes. *Cognitive Psychology,* 7, 44-64.

Obrzut, J., Hynd, G., Obrzut, A. & Pirozzolo, F. (1981). Effect of Directed Attention on Cerebral Asymmetries in Normal and Learning Disabled Children. *Development Psychology, 17,*118-125.

Ornstein, P.A., Naus, M.J. & Liberty, C. (1975). Rehearsal and organizational processes in children's memory. *Child Development,* 46(4), 818-830.

Parrill-Burnstein, M. (1978b). *Card sorting and learning disabilities: A developmental study*. Paper presented at the annual meeting of the Southeastern Psychological Association, Atlanta.

Parrill-Burnstein, M. & Baker-Ward, L. (1979). Learning disabilities: A social-cognitive difference. *Learning Disabilities: An Audio Journal for Continuing Education, 3,* (10).

Pascualvaca, D.M., Fantie, B.D., Papageorgiou, M. & Mirsky, A.F. (1998). Attentional Capacities in Children with Autism: Is There a General Deficit in Shifting Focus? *Journal of Autism and Developmental Disorders, 28(6),* 467-478.

Pennington, B. (1991). *Diagnosing learning disorders*. New York: Guilford Press.

Piaget, J. & Inhelder, B. (1969). *Memory and Intelligence.* New York: Basic Books.

Pick, A.D., Frankel, D.G. & Hess, V.L. (1975). Children's Attention: The Development of Selectivity. *In* E. M. Hetherington (Ed.), *Review of Child Development Research* (Vol. 5). Chicago: University of Chicago Press.

Posner, M.I. & Boies, S.J. (1971). Components of attention. *Psychological Review*, 78,391-408.

Public Law 94-142: The Education for all Handicapped Children Act of 1975. *Federal Register*, Washington D.C.: Office of Education, Department of Health, Education and Welfare.

Reese, H.W. (1976). *Basic learning processes in childhood.* New York: Holt, Rinehart & Winston.

Restle, F. (1962). The selection of strategies in cue learning. *Psychological Review*, 69(4), 329-343.

Richards, G.P., Samuels, S.J., Turnure, J. & Ysseldyke, J. (1990). Sustained and selective attention in children with learning disabilities. *Journal of Learning Disabilities, 23,* 129-136.

Ross, A.O. (1976). *Psychological aspects of Learning Disabilities and Reading Disorders*. New York: McGraw-Hill.

Ross-Swain, D. (1992). *Cognitive Linguistic Improvement Program.* California: Singular Publishing Group.

Shankweiler, D., Lieberman, I.Y., Marks, S.L. & Fischer, F.W. (1984). The speech code and learning to read. *Journal of Experimental Psychology: Human Learning and Memory, 4,* 531-545.

Siegel, L.S. & Under, B.A. (1984). Short-term memory processing in children with reading and arithmetic learning disabilities. *Developmental Psychology, 20,* 200-207.

Silva, S., Williams, P. & McGee (1987). Epidemiological and neurological aspects of learning disabilities. *In* Karanth, P., & Rozario, J. (Eds.), *Learning Disabilities in India* (pp. 30-43). New Delhi: Sage Publications.

Sperling, G. (1960). The information available in brief visual presentations. *Psychological Monographs, 11,* 20-33.

Stanovich, K. & Siegel, L.S. (1994). Phenotypic performance profile of children with reading disabilities: A regression-based test of the phonological-core difference model. *Journal of Educational Psychology, 86,* 24-53.

Sturn, A. (1999). Thinking out loud: an exploration of problem-solving language in preschoolers with and without language impairment. *International Journal of Language & Communication Disorders,* 34(1), 1-15.

Swanson, H.L. (1983a). Relations among metamemory, rehearsal activity and word recall in learning disabled and nondisabled readers. *British Journal of Educational Psychology, 53,*186-194.

Swanson, H.L. (1986). Do semantic differences underlie disabled readers encoding processes? *Journal of Experimental Child Psychology, 41,* 461-488.

Swanson, H.L. (1987). Information processing theory and learning disabilities: An overview. *Journal of Learning Disabilities, 20,* 3-7.

Swanson, H.L. (1993). Executive processing in learning disabled readers. *Intelligence, 17,* 117-149.

Swanson, H.L. (2003). Age-related differences in learning disabled and skilled readers' working memory. *Journal of Experimental Child Psychology, 85,* 1-31.

Swanson, H.L., Ashbaker, M.H. & Lee, C. (1996). Learning-disabled readers' working memory as a function of processing demands. *Journal of Experimental Child Psychology,* 6/(3), 242-75.

Swanson, H.L., Cochrane, K. & Ewers, C. (1989). Working memory and reading disabilities. *Journal of Abnormal Child Psychology, 17*, 745-756.

Swanson, H.L. & Cooney, J.B. (1991). Learning Disabilities. *In* Wong, B.Y.L. (Ed.), *Learning about learning disabilities* (pp. 104-127). New York: Academic Press.

Swanson, H.L., Howard, C.B. & Saez, L. (2006). Do different components of working memory underlie different subgroups of reading disabilities? *Journal of Learning Disabilities, 39*(3), 252-269.

Swanson, H.L. & Mullen, R. C. (1983). Hemispheric Specialization in Learning Disabled Readers' Recall as a Function of Age and Level of Processing. *Journal of Experimental Child Psychology, 35*, 457-477.

Swanson, H.L. & Obrzut, J. (1985). Learning Disabled Readers' Recall as a Function of Distinctive Encoding, Hemisphere Processing and Selective Attention. *Journal of Learning Disabilities, 18*(7), 409-418.

Swettenham, J., Baron-Cohen, S., Charman, T., Cox, A., Baird, G., Drew, A., Rees, L. & Wheelwright, S. (1998). The Frequency and Distribution of Spontaneous Attention Shifts between Social and Nonsocial Stimuli in Autistic, Typically Developing, and Nonautistic Developmentally Delayed Infants. *Journal of Child Psychology and Applied Psychiatry, 39*, 747-753.

Tallal, P. (1976). Rapid auditory processing in normal and disordered language development. *Journal of Speech and Hearing, 3*, 561–571.

Tarnowski, K.J., Prinz, R.J. & Nay, S. M. (1986). Comparative analysis of attentional deficits in hyperactive and learning-disabled children. *Journal of Abnormal Psychology, 95*, 341-345.

Teunisse, J.P. & de Gelder, B. (2001). Impaired categorical perception of facial expressions in high-functioning adolescents with autism. *Neuropsychological Development, Cognition and Child Neuropsychology, 7*, 1 –14.

Thorndike, R.L., Hagen, E.P. & Lorge, I.D. (1972). Standardized tests of intelligence or scholastic aptitude. *In* Thorndike, R.L. & Hagen, E.P. (Eds.), *Measurement and Evaluation in Psychology and Education* (pp. 296-350). New Delhi: Wiley Eastern Limited.

Torgesen, J.K. (1988). Studies of children with learning disabilities who perform poorly on memory span tasks. *Journal of Learning Disabilities, 21*(10), 605-612.

Toro, PA., Weissberg, R.P., Guare, J. & Liebenstein, N.L. (1990). A comparison of children with and without learning disabilities on social problem-solving skill, school behavior, and family background. *Journal of Learning Disabilities,* 23(2), 115-120.

Tulving, E. (1973). Episodic and semantic memory. In Tulving, E. & Donaldson, W. (Eds.), *Organization of memory* (pp. 382-404). New York: Academic Press.

Vygotsky, L.S. (1962). *Thought and language.* (E. Hanfmann & Gertrude Vakar, Eds. and transl.) Cambridge: MIT Press.

Wallas, G. (1926). *The art of thought.* New York: Harcourt Brace Jovanovich.

Watson, R. I. (1963). Attention Deficit Disorder. *In* Gaddes, W.H. & Edgell, D. (Eds.), *Learning disabilities and brain function: A neuropsychological approach* (pp. 253-303). New York: Springer-Verlag.

Wechsler, D. (1949). *Manual for the Wechsler Intelligence Scale for Children.* New York: Psychological Corporation.

Wechsler, D. (1968). *Manual for the Wechsler Preschool and Primary Scale of Intelligence.* New York: Psychological Corporation.

Wechsler, D. (1974). *Manual for the Wechsler Intelligence Scale for Children - Revised.* New York: Psychological Corporation.

Weismer, S.E., Evans, J. & Hesketh, L.J. (1999). An examination of verbal working memory capacity in children with specific language impairment. *Journal of Speech, Language, and Hearing Research*, *42*, 1249-1260.

Westerberg, H., Hirvikoski, T., Forssberg, H. & Klingberg, T. (2004). Visuo-spatial working memory span: a sensitive measure of cognitive deficits in children with ADHD. *Child Neuropsychology,* 10(3), 155-161.

Whalen, C. K. & Henker, B. (1991). The social impact of stimulant treatment for hyperactive children. *Journal of Learning Disabilities, 24,* 231-241.

Williams, D.L., Goldstein, G. & Minshew, N.J. (2006). The profile of memory function in children with autism. *Neuropsychology,* 20(1), 1-9.

Williams, D.L., Goldstein, G., Carpenter, P.A. & Minshew, N.J. (2005). Verbal and Spatial Working Memory in Autism. *Journal of Autism and Developmental Disorders,* 35(6), 747-756.

Wong, B.Y.L. (1982). Strategic behaviors in selecting retrieval cues in gifted, normal achieving and learning disabled children. *Journal of Learning Disabilities,* 75,33-37.

Wright, J.C. & Vlietstra, A.G. (1975). The Development of Selective Attention: From Perceptual Exploration to Logical Search. In H. Reese (Ed.), *Advances in Child Development and Behavior* (Vol. 10). New York: Academic Press.

Wu, K.K., Anderson, V. & Castiello, U. (2006). Attention-Deficit/Hyperactivity Disorder and working memory: a task switching paradigm. *Journal of Clinical and Experimental Neuropsychology*, 25(8), 288-306.

Wyatt, B.S. & Conners, F. A. (1998). Implicit and explicit memory in individuals with mental retardation. *American journal on Mental Retardation, 102(5),* 511-526.

APPENDIX I

COGNITIVE LINGUISTIC ASSESSMENT PROTOCOL FOR CHILDREN WITH LEARNING DISABILITIES

DOMAIN I

I. ATTENTION/DISCRIMINATION

1. AUDITORY MODE

(1) Digit count test

Instructions: "I am going to present some digits in a sequence, you have to listen to it carefully and tell me the number of times you heard the digit '9'."

"ನಾನು ಕೆಲವು ಸಂಖ್ಯೆಗಳನ್ನು ಹೇಳುತ್ತೇನೆ. ನೀವು ಅವುಗಳಲ್ಲಿ ಎಷ್ಟು ಬಾರಿ ಒಂಭತ್ತು ಸಂಖ್ಯೆಯನ್ನು ಕೇಳುವಿರಿ ಎಂದು ಲೆಕ್ಕಹಾಕಿ ಹೇಳಿರಿ".

Level-I	9	19	29	9	15	69	8	9	7				
Level-II	21	9	65	99	3	9	89	9	12	90			
Level-III	6	ba	7	ka	9	10	9	na	9	6	16		
Level-IV	9	60	19	79	9	8	18	9	ka	9	16	91	
Level-V	da	tu	9	9	15	na	6	9	8	8	9	78	66

(2) Sound count test

Instructions: "I am going to present some sounds in a sequence, you have to listen to it carefully and tell me the number of times you heard the sound 'ba'."

"ನಾನು ಕೆಲವು ಶಬ್ಧಗಳನ್ನು ಹೇಳುತ್ತೇನೆ. ನೀವು ಅವುಗಳಲ್ಲಿ ಎಷ್ಟು ಬಾರಿ 'ಬ' ಶಬ್ಧವನ್ನು ಕೇಳುವಿರಿ ಎಂದು ಲೆಕ್ಕಹಾಕಿ ಹೇಳಿರಿ".

Level-I	ಟ	ಕ	ಪ	ಪ	ಬ	ನ	ಲ	ರ	ಸ		
Level-II	ನ	ಟ	ಪ	ಬ	ಹ	ನ	ಬ	ಚ	ಲ		
Level-III	ಕ	ಪ	ಬ	ವ	ಚ	ಬ	ನ	ಹ	ನ	ಮ	
Level-IV	ಮ	ಬ	ವ	ಕ	ಬ	ತ	ರ	ಲ	ವ	ಬ	ಹ
Level-V	ಬ	ನ	ಸ	ಮ	ವ	ಬ	ಲ	ಪ	ಬ	ಮ	ವ

(3) Auditory word discrimination

Instructions: "I am going to present two similar sounding words. You have to listen carefully and tell me whether the two words are the same or different".

"ನಾನು ಎರಡು ಸಮಾನವಾಗಿ ಕೇಳಿಸುವ ಪದಗಳನ್ನು ಹೇಳುತ್ತೇನೆ. ನೀವು ಆ ಪದಗಳು ಒಂದೇ ಅಥವಾ ಬೇರೆ ಬೇರೆ ಎಂಬುದನ್ನು ಹೇಳಿರಿ".

ಸಂಕಟ	ಸಂಗಡ	ಮಗಳು	ಮುಗುಳು	ಗುಣಿತ	ಗುಣಿತ
ಮುಗಿಲು	ಮಿಗಿಲು	ಗುಳಿಗೆ	ಗಳಿಗೆ	ಓಡಿದ	ಓದಿದ
ಪಾಲಕ	ಬಾಲಕ	ಹಲ್ಲಿ	ಹಳ್ಳಿ	ಸೂರ್ಯ	ಸೂರ್ಯ
ನಿಪುಣ	ಜಿಪುಣ				

2. VISUAL MODE

(1) Odd one out test

Instructions: "I will show you a set of pictures you have to point to the picture that does not belong to the set i.e. the odd picture".

"ಗುಂಪಿಗೆ ಸೇರದ ಚಿತ್ರ ಯಾವುದೆಂದು ತೋರಿಸಿ".

Level-I	Ia	Ib	Ic	Id		
Level-II	IIa	IIb	IIc	IId	IIe	
Level-III	IIIa	IIIb	IIIc	IIId	IIIe	
Level-IV	IVa	IVb	IVc	IVd	IVe	
Level-V	Va	Vb	Vc	Vd	Ve	Vf

NOTE: See Appendix II for odd one out test.

Key answers:			
	Level I	-	Ib
	Level II	-	IIb
	Level III	-	IIId
	Level IV	-	IVe
	Level V	-	Vc

(2) Letter/word cancellation test

Instructions for Level I: "You have to show the letter 'i' from the sequence of letters".

"ಇಲ್ಲಿ ಕೊಟ್ಟಿರುವ ಶಬ್ಧಗಳಿಂದ 'ಇ' ಶಬ್ಧವನ್ನು ಗುರುತಿಸಿ".

Instructions for Level II: "You have to show the red colored 'i' from the sequence of letters".

"ಕೇವಲ ಕೆಂಪು ಬಣ್ಣದಲ್ಲಿರುವ 'ಇ' ಶಬ್ಧವನ್ನು ಗುರುತಿಸಿ".

Instructions for Level III: "Show me the red colored" preceding every red colored 'ka'.

"ಕೇವಲ ಕೆಂಪು ಬಣ್ಣದ 'ಇ' ಶಬ್ಧ ಕೆಂಪು ಬಣ್ಣದ 'ಕ' ಶಬ್ಧದ ಮುಂಚೆ ಬಂದರೆ ಗುರುತಿಸಿ".

Instructions for Level IV: "Show me the red colored 'i' preceding every blue colored /ba'.

"ಕೇವಲ ಕೆಂಪು ಬಣ್ಣದ 'ಇ' ಶಬ್ಧ ನೀಲಿ ಬಣ್ಣದ 'ಕ' ಶಬ್ಧದ ಮುಂಚೆ ಬಂದರೆ ಗುರುತಿಸಿ".

Instructions for Level V: "Show one the word 'red' written in blue"

"ಈ ಪದಗಳಲ್ಲಿ ನೀಲಿ ಬಣ್ಣದಲ್ಲಿರುವ 'ಕೆಂಪು' ಎಂಬ ಪದಗಳನ್ನು ಗುರುತಿಸಿ".

NOTE: See Appendix II for letter/word cancellation test.

3. Visual word discrimination

Instructions: "I am going to present two similar - looking words. You have to look carefully and tell me whether the two words appear the same or different".

"ನಾನು ಎರಡು ಸಮಾನವಾಗಿ ಕಾಣುವ ಪದಗಳನ್ನು ತೋರಿಸುತ್ತೇನೆ. ನೀವು ಆ ಪದಗಳು ಒಂದೇ ಅಥವಾ ಬೇರೆ ಬೇರೆ ಎಂಬುದನ್ನು ಹೇಳಿರಿ".

ಬಿದುರು	ಬಿದಿರು	ಆಹಾರ	ಆಧಾರ	ಬಳಪು	ಬಳಪ
ಅಗಸ	ಅಗಲ	ಕಮಲ	ಕಮಲ	ಕವನ	ಕದನ
ಆಡುವ	ಹಾಡುವ	ತವರು	ತವರ	ಜವಳಿ	ಜವಳಿ
ಜನಕ	ಜನನ				

DOMAIN II

II. MEMORY

1. AUDITORY MODE

(1) Digit forward span

Instructions: "I am going to tell some digits in a sequence, you have to repeat after I finish".
"ನಾನು ಕೆಲವು ಸಂಖ್ಯೆಗಳನ್ನು ಹೇಳುತ್ತೇನೆ, ನೀವು ಅದೇ ರೀತಿಯಲ್ಲಿ ನಂತರ ಪ್ರತಿ ಹೇಳಬೇಕು".

Level-I	8	2	1	9	3				
Level-II	2	5	7	6	8	4			
Level-III	6	8	9	1	4	8	3		
Level-IV	1	4	5	8	7	1	2	9	
Level-V	9	8	1	7	4	3	2	3	6

(2) Word recall

Instructions: "I am going to tell some words, you have to repeat after I finish, irrespective of the sequence".
"ನಾನು ನಿಮಗೆ ಕೆಲವು ಪದಗಳನ್ನು ಹೇಳುತ್ತೇನೆ, ನೀವು ಆ ಪದಗಳನ್ನು ನಾನು ಹೇಳಿದ ನಂತರ ಹೇಳಬೇಕು".

Level-I	ಮರ,	ಬಂಡೆ,	ನೀರು,	ಹೊಳೆ,	ಬೆಟ್ಟ				
Level-II	ಶೂಸ್,	ಚಪ್ಪಲಿ,	ಲಂಗ,	ಶರ್ಟ್,	ಟೋಪಿ,	ಸೀರೆ			
Level-III	ಚಮಚ,	ಸೇಬು,	ಕುರ್ಚಿ,	ಕೋಳಿ,	ಗುಲಾಬಿ,	ಪೆನ್ನು,	ಗಂಟೆ		
Level-IV	ಬ್ರಷ್,	ಬೆಣ್ಣೆ,	ಕೆಂಪು,	ಕೋಲು,	ಪಟ,	ಒಂಟೆ,	ಆಟೋ,	ಕಣ್ಣು	
Level-V	ಕಮಲ,	ಸೋಪು,	ಕಾರು,	ಬಾಚಣಿಗೆ,	ದೀಪ,	ಹಾಲು,	ದ್ರಾಕ್ಷಿ	ಇಲಿ,	ಕಾಗೆ

(3) Digit backward

Instructions: "I am going presenting a series of digits and you have to repeat back, in a reverse order".
"ನಾನು ಕೆಲವು ಸಂಖ್ಯೆಗಳನ್ನು ಹೇಳುತ್ತೇನೆ, ನೀವು ಅದನ್ನು ಕೊನೆಯಿಂದ ಮೊದಲಿಗೆ ಹೇಳಬೇಕು".

Level-I	9	7	1	8			
Level-II	5	4	1	6	8		
Level-III	8	3	4	9	7	6	
Level-IV	14	2	7	9	3	6	2
Level-V	6	7	9	8	4	1	5

2. VISUAL MODE

(1) Alternate sequencing task

Instructions: "I will be showing you a sequence of pictures/shapes, and you have to tell what comes next in the blank, out of the four choices".
"ನಾನು ಕ್ರಮದಲ್ಲಿರುವ ಕೆಲವು ಚಿತ್ರಗಳು ಅಥವಾ ಆಕಾರಗಳನ್ನು ತೋರಿಸುತ್ತೇನೆ. ಬಿಟ್ಟ ಜಾಗದಲ್ಲಿ ನೀವು ಕೆಳಗೆ ಕೊಟ್ಟಿರುವ ನಾಲ್ಕು ಚಿತ್ರಗಳಲ್ಲಿ ಯಾವುದು ಸೂಕ್ತ ಅದನ್ನು ಗುರುತಿಸಿ ತೋರಿಸಿ".

NOTE: See Appendix II for alternate sequencing task

(2) Picture counting

Instructions: "I will be showing you some pictures in a sequence and you have to recall and name them after I have removed them".

"ನಾನು ನಿಮಗೆ ಕೆಲವು ಚಿತ್ರಗಳನ್ನು ತೋರಿಸುತ್ತೇನೆ. ಆ ಚಿತ್ರಗಳನ್ನು ತೆಗೆದಮೇಲೆ, ನೀವು ಈ ಚಿತ್ರಗಳನ್ನು ಹೆಸರಿಸಬೇಕು".

Level-I	Ia	Ib	Ic	Id	Ie			
Level-II	IIa	IIb	IIc	IId	IIe	IIf		
Level-Ill	IIIa	IIIb	IIIc	IIId	IIIe	IIIf	IIIg		
Level-IV	IVa	IVb	IVc	IVd	IVe	IVf	IVg	IVh	
Level-V	Va	Vb	Vc	Vd	Ve	Vf	Vg	Vh	Vi

NOTE: See Appendix II for picture counting task.

(3) Story sequencing

Instructions: "I will be showing you some picture cards of stories. The cards of each story will be jumbled and you have to arrange the cards in the correct order of the story".

"ನಾನು ಕೆಲವು ಕಥೆಗಳ ಕಾರ್ಡ್‌ಗಳನ್ನು ನಿಮ್ಮ ಮುಂದೆ ಇಡುತ್ತೇನೆ. ಅವು ಒಂದೇ ಕ್ರಮದಲ್ಲಿಲ್ಲ. ಅದನ್ನು ಕಥೆಯ ಆಧಾರದ ಮೇಲೆ ಕ್ರಮದಲ್ಲಿ ಜೋಡಿಸಬೇಕು".

Level-I	Ia	Ib	Ic	Id	Ie	If		
Level-II	IIa	IIb	IIc	IId	IIe	IIf		
Level-III	IIIa	IIIb	IIIc	IIId	IIIe	IIIf		
Level-IV	IVa	IVb	IVc	IVd	IVe	IVf		
Level-V	Va	Vb	Vc	Vd	Ve	Vf	Vg	Vh

NOTE: See Appendix II for Story Sequencing

DOMAIN III

III. PROBLEM SOLVING

1. AUDITORY MODE

(1) Predicting cause

Instructions: "Tell me why the following happen"

"ಈ ರೀತಿಯಾಗಿ ಏಕೆ ಆಗುವುದೆಂದು ಹೇಳಿರಿ"

೧. ನಿನ್ನ ಗೆಳೆಯ ಗೆಳತಿ ನಿನ್ನ ಜೊತೆ ಮಾತನಾಡೋದಿಲ್ಲ.

೨. ನಿನ್ನ ಗಿಡಗಳು ಬಾಡಿಹೋಗಿವೆ.

೩. ನಿನ್ನ ಬೀಗದಕೈಯಿಂದ ಬೀಗವನ್ನು ತೆಗೆಯಲು ಆಗುತ್ತಿಲ್ಲ.

೪. ನೀನು ಮಳೆಯಲ್ಲಿ ನೆನೆಯುತ್ತೀಯಾ.

೫. ನಿನ್ನ ಗಾಡಿ ಸ್ಟಾರ್ಟ್ ಆಗುತ್ತಿಲ್ಲ.

೬. ನಿನಗೆ ಬೋರ್ಡ್ ನೋಡಿಕೊಂಡು ಓದುವುದಕ್ಕೆ ಕಷ್ಟವಾಗುತ್ತದೆ.

೭. ನಿನ್ನ ಕಾರಿನ ಚಕ್ರ ಚಪ್ಪೆಯಾಗಿದೆ.

೮. ಅಡಿಗೆ ಮನೆಯಲ್ಲಿ ಹೊಗೆ ತುಂಬಿದೆ.

೯. ನಿನ್ನ ಆರೋಗ್ಯ ಕೆಟ್ಟಿದೆ.

೧೦. ನಿನಗೆ ಉಸಿರಾಡಲು ಆಗುತ್ತಿಲ್ಲ.

(2) Predicting Outcome

Instructions: "What will you do if this happens"?

"ಒಂದು ವೇಳೆ ಹೀಗಾದರೆ ನೀವೇನು ಮಾಡುವಿರಿ"?

೧. ನಿನ್ನ ಟೆಲಿಫೋನ್ ಕೆಲಸ ಮಾಡದಿದ್ದರೆ

೨. ನೀನು ಒಂದು ಕೋಣೆಯಲ್ಲಿ ಸಿಕ್ಕಿಬಿದ್ದರೆ

೩. ನೀನು ಪರೀಕ್ಷೆಯಲ್ಲಿ ಉತ್ತರಗಳನ್ನು ಮರೆತರೆ

೪. ಕರೆಂಟ್ ಅಕಸ್ಮಾತ್ತಾಗಿ ಹೊರಟುಹೋದರೆ

೫. ನೀನು ನಿನ್ನ ಮನೆಯ ಬೀಗದಕ್ಕೆ ಕಳೆದುಕೊಂಡರೆ

೬. ನೀನು ನಿನ್ನ ಬೆರಳನ್ನು ಚೂಪಾದ ವಸ್ತುವಿನಿಂದ ಕತ್ತರಿಸಿಕೊಂಡರೆ

೭. ನಿನಗಿಂತ ಚಿಕ್ಕವರು ನಿನ್ನ ಜೊತೆ ಮಿಠಾಯಿಗೆ ಜಗಳವಾಡಿದರೆ

೮. ಬೇರೆಯವರಿಂದ ಕೇಳಿಪಡೆದ ಬೆಲೆ ಬಾಳುವ ವಸ್ತುವನ್ನು ನೀನು ಕಳೆದುಕೊಂಡರೆ

೯. ನೀನು ಒಂದು ಪತ್ರಕ್ಕೆ ಸ್ಟಾಂಪ್ ಹಾಕದೇ ಪೋಸ್ಟ್ ಮಾಡಿಬಿಟ್ಟರೆ

೧೦. ನೀನು ರೈಲಿನ ಹಳಿ ಮುರಿದುಹೋಗಿದೆ ಎಂದು ಗುರುತಿಸಿದೆ. ತಕ್ಷಣ ರೈಲು ಬರುವುದನ್ನು ನೋಡಿದರೆ

(3) Compare and contrast

Instructions: "I will tell you a pair of words you have to tell me two similarities and two differences between them".

"ನಾನು ಹೇಳುವ ವಸ್ತುಗಳಲ್ಲಿ ಎರಡು ಸಮಾನತೆಗಳನ್ನು ಹಾಗೂ ಎರಡು ವ್ಯತ್ಯಾಸಗಳನ್ನು ಹೇಳಿರಿ".

೧. ಮಾವಿನ ಹಣ್ಣು ಮತ್ತು ಬಾಳೆಹಣ್ಣು

೨. ಬೆಕ್ಕು ಮತ್ತು ಇಲಿ

೩. ಪಿಯಾನೋ ಮತ್ತು ಕೊಳಲು

೪. ಹಾಲು ಮತ್ತು ಔಷಧ

೫. ಚೆಂಡು ಮತ್ತು ಬಲೂನು

೬. ಉಪ್ಪು ಮತ್ತು ನೀರು

೭. ನ್ಯೂಸ್‌ಪೇಪರ್ ಮತ್ತು ಮ್ಯಾಗಜೈನ್

೮. ಫೋಟೋ ಮತ್ತು ಚಲನಚಿತ್ರ

೯. ಅಪಾರ್ಟ್‌ಮೆಂಟ್ ಮತ್ತು ಮನೆ

೧೦. ಸ್ಟೌವ್ ಮತ್ತು ಫ್ರಿಡ್ಜ್

2. VISUAL MODE

(1) Association Task

Instructions: "I will be showing you a set of pictures. You have to tell me the relation between the pictures"

"ಈ ಚಿತ್ರಗಳೆಲ್ಲ ಯಾವುದೋ ಒಂದು ರೀತಿಯಲ್ಲಿ ಸಂಬಂಧಿಸಿವೆ. ಅವುಗಳ ಸಂಬಂಧ ಏನೆಂಬುದನ್ನು ಗುರುತಿಸಿ ಹೇಳಿರಿ".

Level-I	Ia	Ib	Ic	Id	Ic	If
Level-II	IIa	IIb	IIc	IId	IIc	IIf
Level-III	IIIa	IIIb	IIIc	IIId	IIIc	IIIf
Level-IV	IVa	IVb	IVc	IVd	IVc	IVf
Level-V	Va	Vb	Vc	Vd	Vc	Vf

NOTE: See Appendix II for Association Task

Key answers :	Level I		ಉದ್ಯೋಗಗಳು
	Level II		ಹಾಲಿನ ಉತ್ಪಾದನೆಗಳು
	Level III	-	ಜಲಚರ ಪ್ರಾಣಿಗಳು
	Level IV	-	ಹಾರದಿರುವ ಹಕ್ಕಿಗಳು
	Level V		ಸಸ್ಯಾಹಾರಿ ಪ್ರಾಣಿಗಳು

(2) Overlapping Test

Instructions: "There are many items hidden in these pictures. Identify and name them"

"ಈ ಚಿತ್ರಗಳಲ್ಲಿ ಅನೇಕ ವಸ್ತುಗಳು ಅಡಗಿವೆ. ಆ ವಸ್ತುಗಳು ಯಾವುದೆಂದು ಗುರುತಿಸಿ ಹೆಸರಿಸಿ".

Level-I	:	L-I
Level-II	:	L-II
Level-III	:	L-III
Level-IV	:	L-IV
Level-V	:	L-V

NOTE: See Appendix II for Story Sequencing

Key answers :	Level I	-	ಆನೆ, ಕೋಳಿ, ಹಾವು, ನಾಯಿ, ಬೆಕ್ಕು, ಇಲಿ, ಮೀನು
	Level II	-	ಶರಟು, ಪ್ಯಾಂಟು, ಟೋಪಿ, ಶೂಸ್, ಉದ್ದನೆಯ ಲಂಗ, ಸಾಕ್ಸ್, ತುಂಡುಲಂಗ
	Level III	-	ಕಣ್ಣು, ಕಿವಿ, ಮೂಗು, ತುಟಿಗಳು
	Level IV	-	ಬಾತುಕೋಳಿ, ಸೇಬು, ಹೂವು, ಚಮಚ, ಶೂಸ್
	Level V	-	ನಲ್ಲಿ, ಕನ್ನಡಕ, ವಿಮಾನ, ಕಮಲ, ಮುಂಬತ್ತಿ, ಬಾಳೇಹಣ್ಣು, ತಿಮಿಂಗಿಲ

(3) Mazes

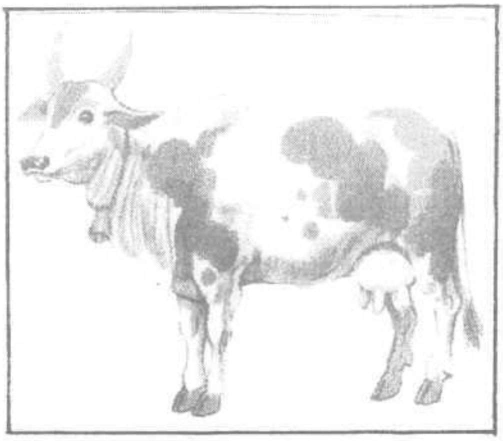
Instructions: "Connect the starting point to the endpoint by a continuous line"

"ಹಾದಿಯ ಅವ್ಯವಸ್ಥೆಯ ಮೂಲಕ ಗುರಿಯನ್ನು ಮುಟ್ಟಬೇಕು"

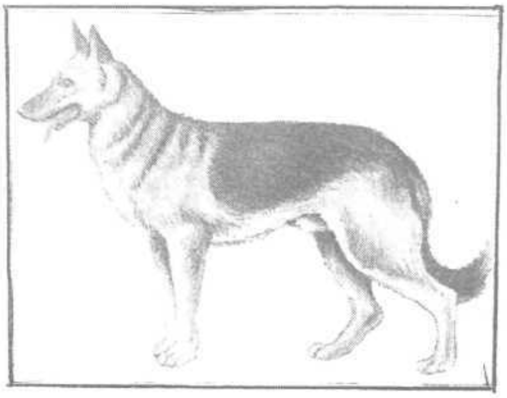
Level-I	:	L-I
Level-II	:	L-II
Level-III	:	L-III
Level-IV	:	L-IV
Level-V	:	L-V

NOTE: See Appendix II for Mazes.

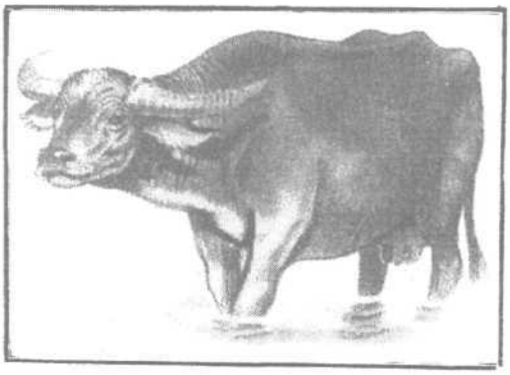
APPENDIX-II
ODD ONE OUT TEST
LEVEL-I



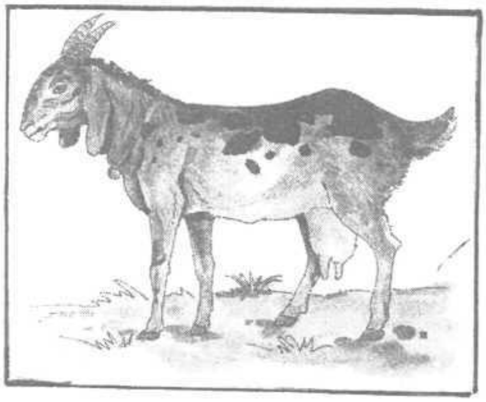
Ia



Ib

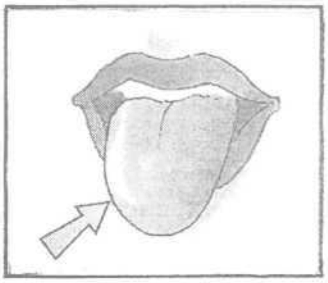


Ic



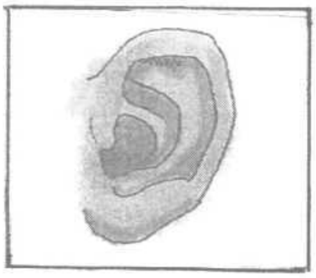
Id

LEVEL - II

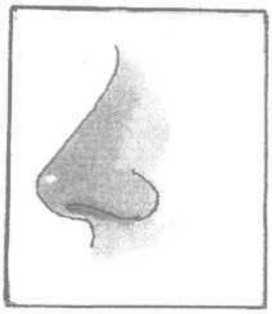


IIa

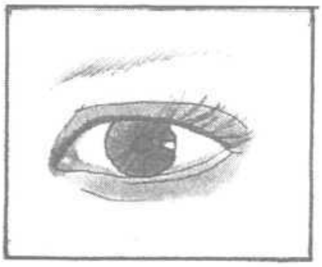
IIb



IIc

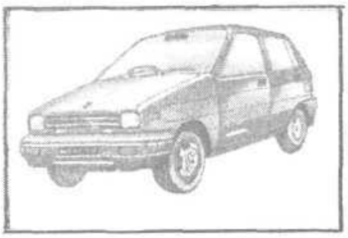


IId

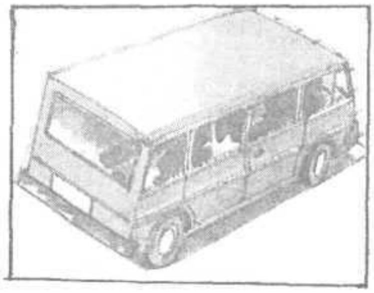


IIe

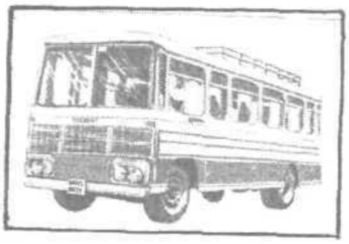
LEVEL - III



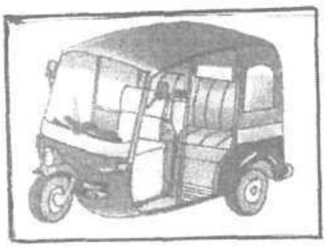
IIIa



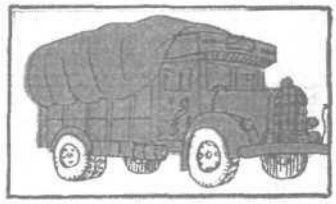
IIIb



IIIc

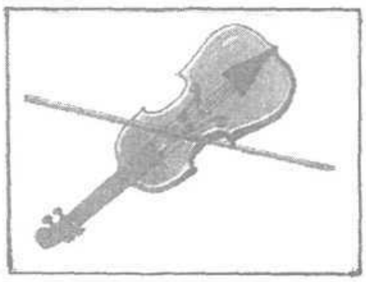


IIId

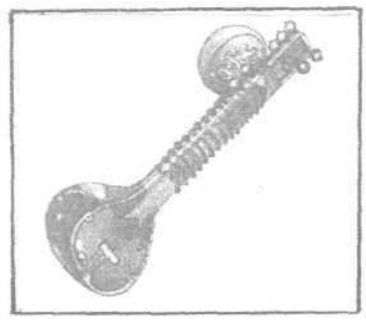


IIIe

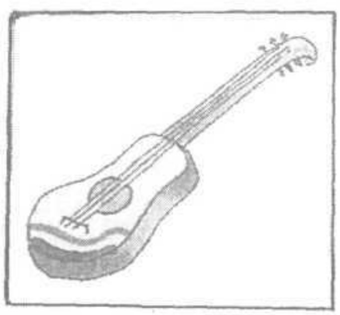
LEVEL - IV



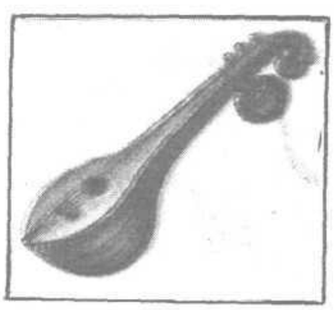
IVa



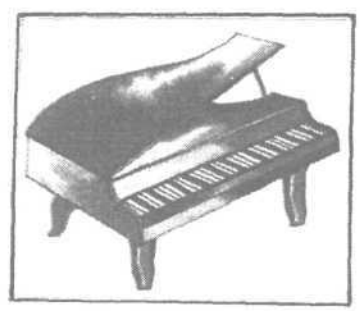
IVb



IVc

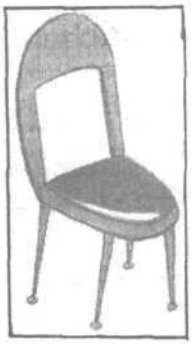


IVd

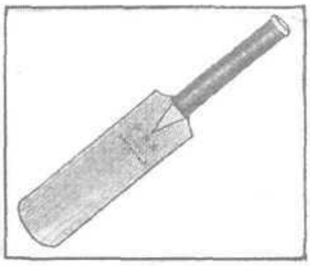


IVe

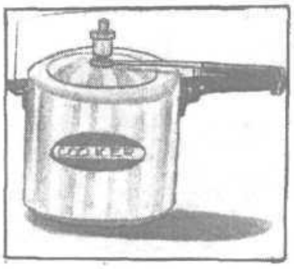
LEVEL-V



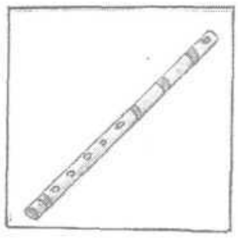
Va



Vb

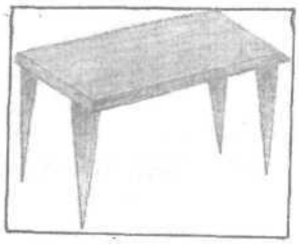


Vc



Vd

Ve



Vf

LETTER | WORD CANCELLATION

LEVEL I:

ಢ ತ ಹ ಗ ಫ ಇ ರ ಲ ಇ ಕ ನ ಇ

LEVEL II:

ಪ ಇ ತ ನ ಇ ರ ಪ ಇ ತ ಇ ರ ಲ ಇ ಇ

LEVEL III:

ಇ ಕ ಹ ಗ ಇ ಪ ಇ ಕ ಲ ನ ಇ ಪ ಜ ಇ ಕ ನ

LEVEL IV:

ಳ ಲ ಇ ಕ ಅ ಯ ವ ಕ ಇ ಕ್ಷ ಯ ಇ ಕ ಗ ಸ ಇ ಬ ಲ

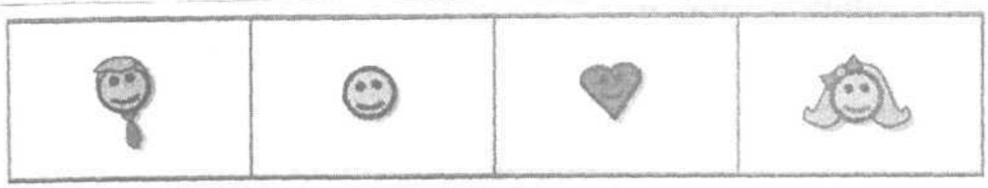
LEVEL V:

ಕೆಂಪು ನೀಲಿ ಕೆಂಪು ನೀಲಿ ಹಸಿರು ಕೆಂಪು ಹಸಿರು ನೀಲಿ

ALTERNATE SEQUENCING TASK

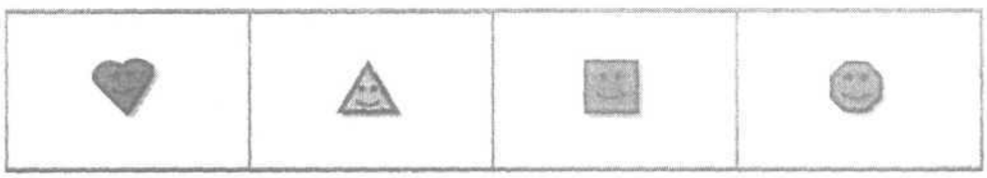
What comes next?

(1)



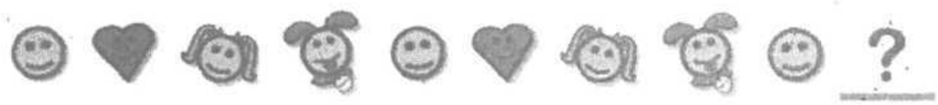
What comes next?

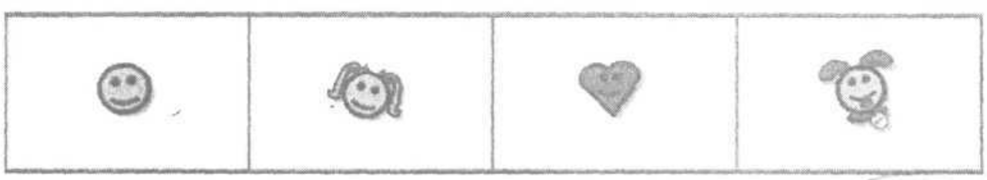
(2)



What comes next?

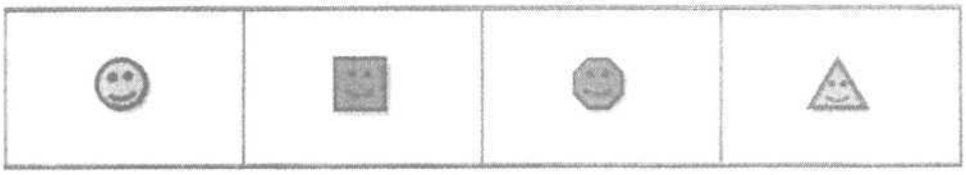
(3)



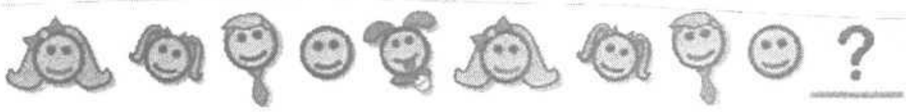


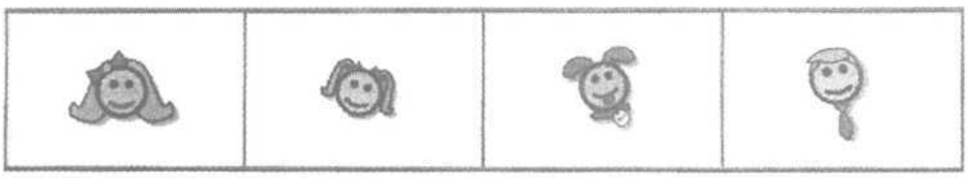
What comes next?

(4)



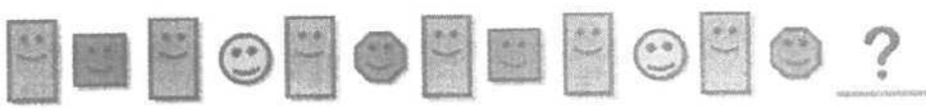
(5)

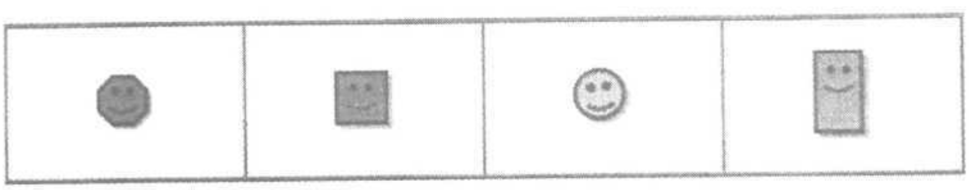




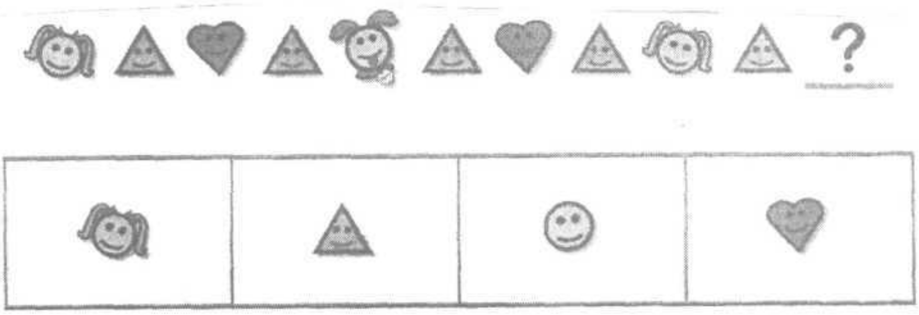
What comes next?

(6)

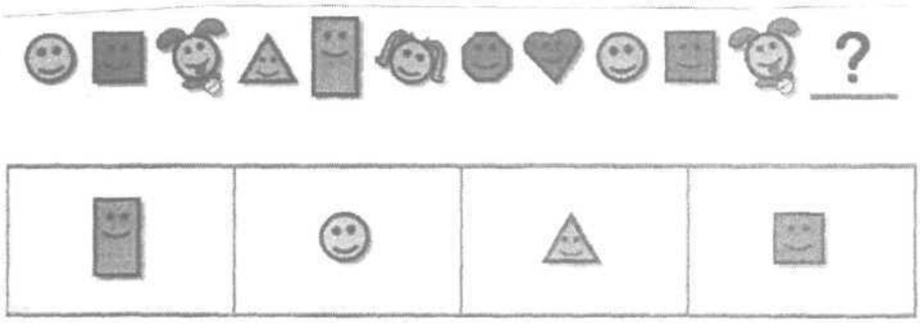




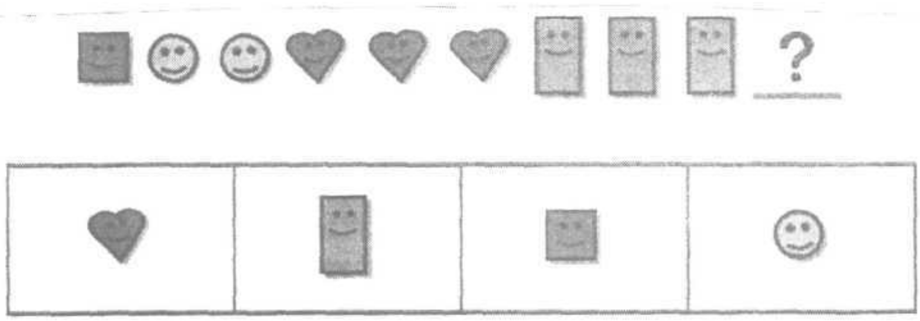
⑦



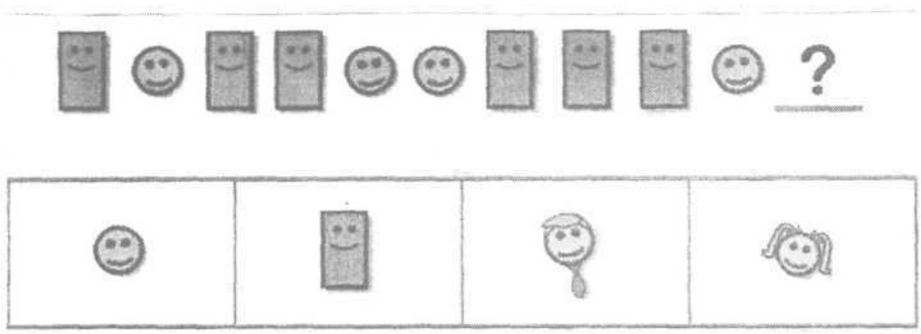
⑧



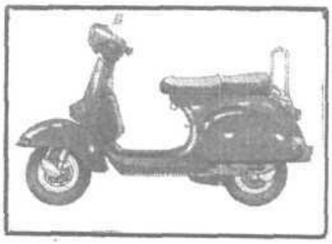
⑨



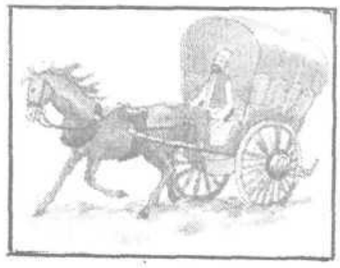
⑩



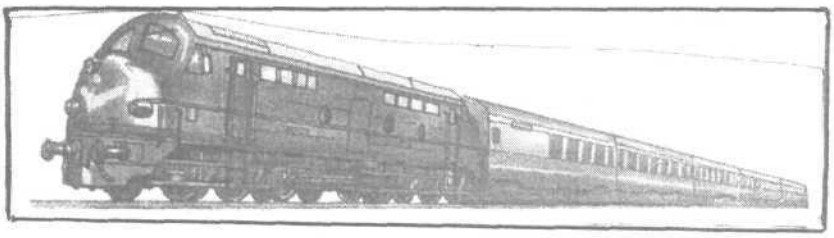
PICTURE COUNTING TEST
LEVEL-I



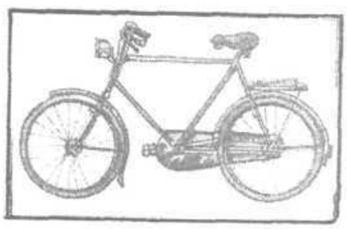
Ia



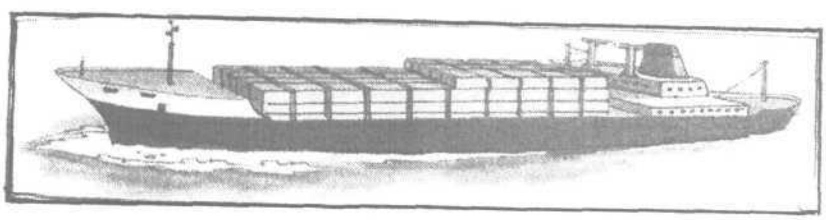
Ib



Ic



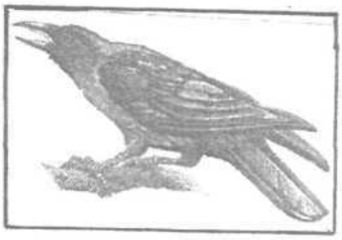
Id



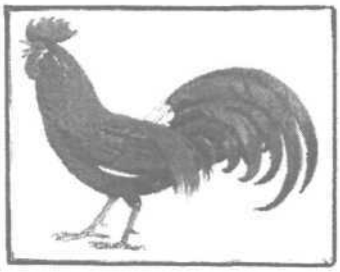
Ie

LEVEL-II

II a

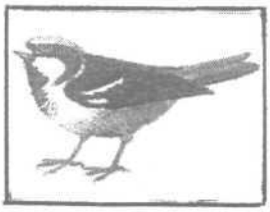


II b

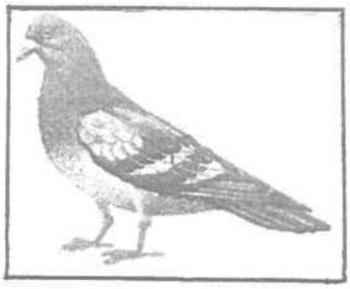


II c

II d

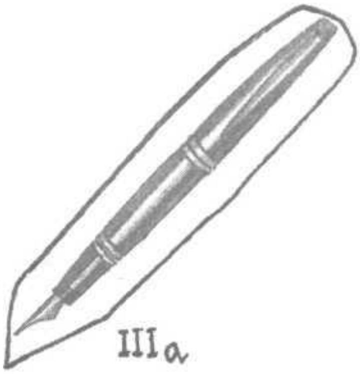


II e



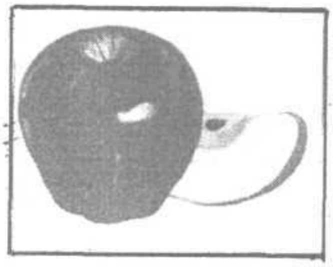
II f

LEVEL - III

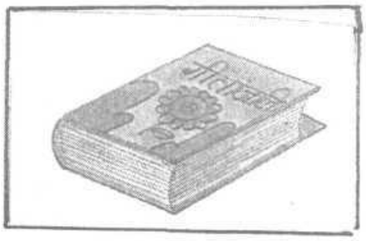


III a

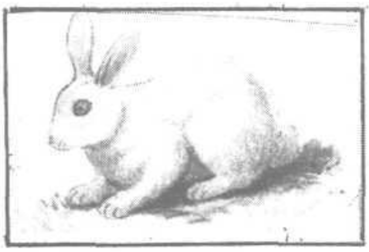
III b



III c



III d

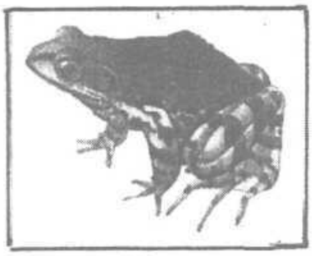


III e

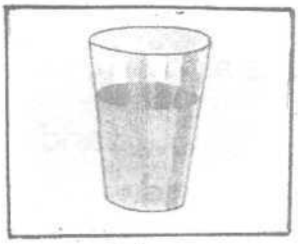
III f

III g

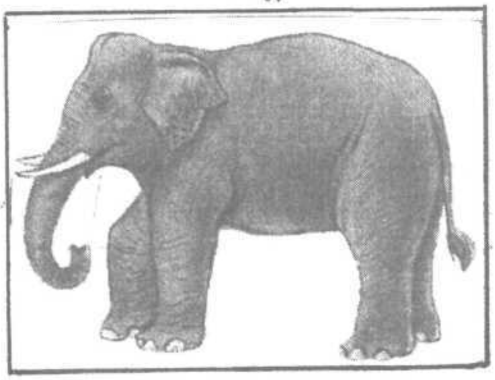
LEVEL-IV



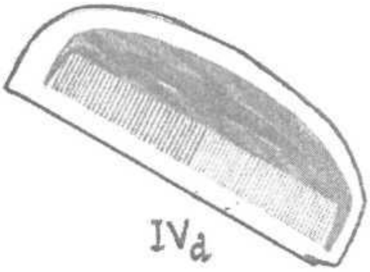
IV_a



IV_b

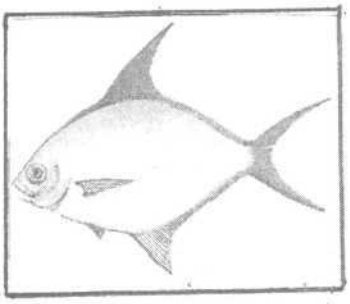


IV_c

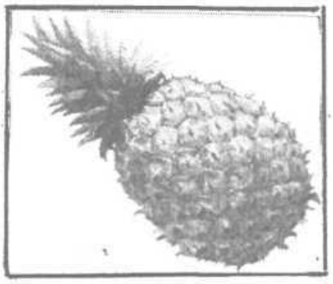


IV_d

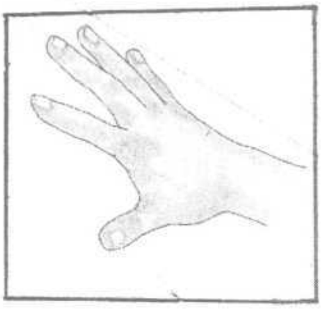
IV_e



IV_f

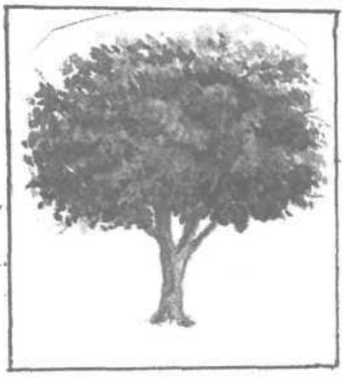


IV_g



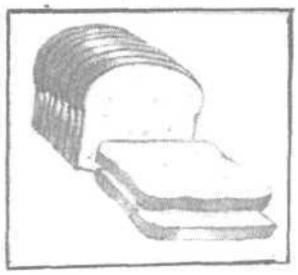
IV_h

LEVEL - V



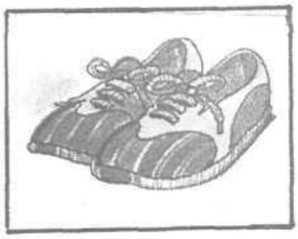
Va

Vb

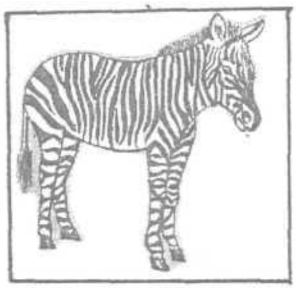


Vc

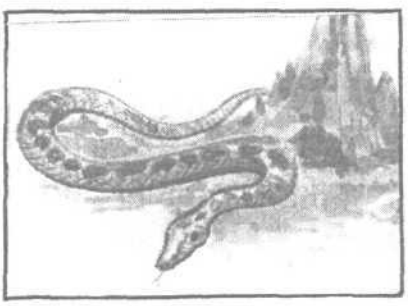
Vd



Ve

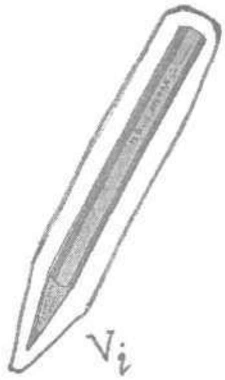


Vf



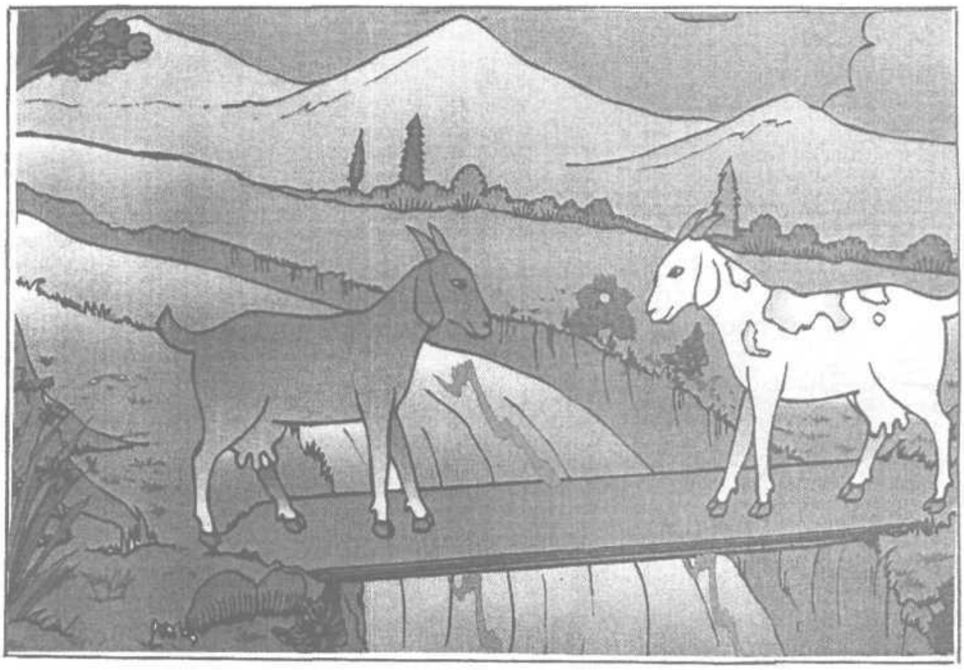
Vg

Vh

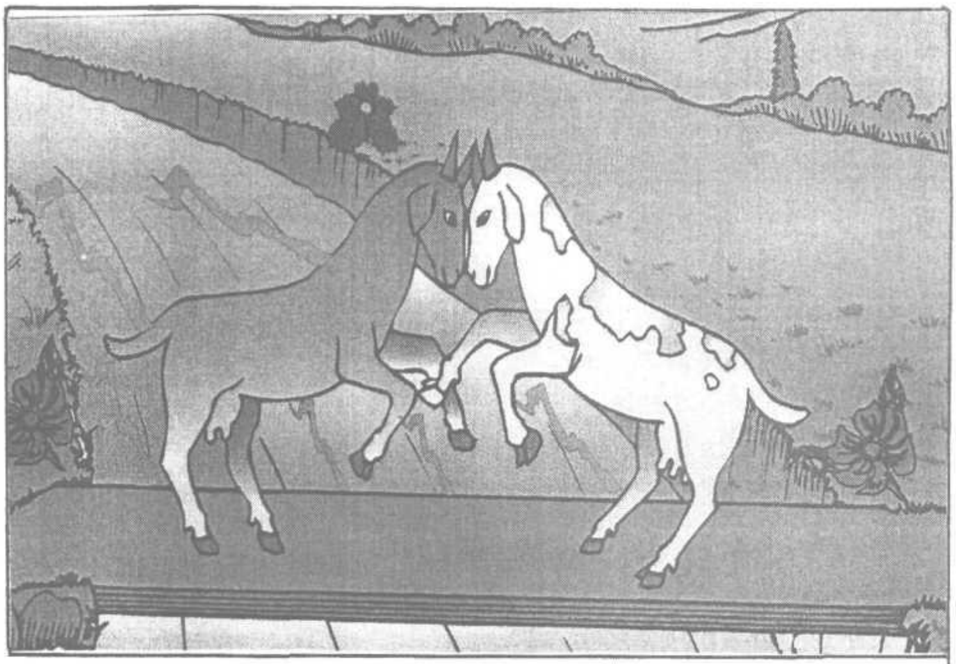


Vi

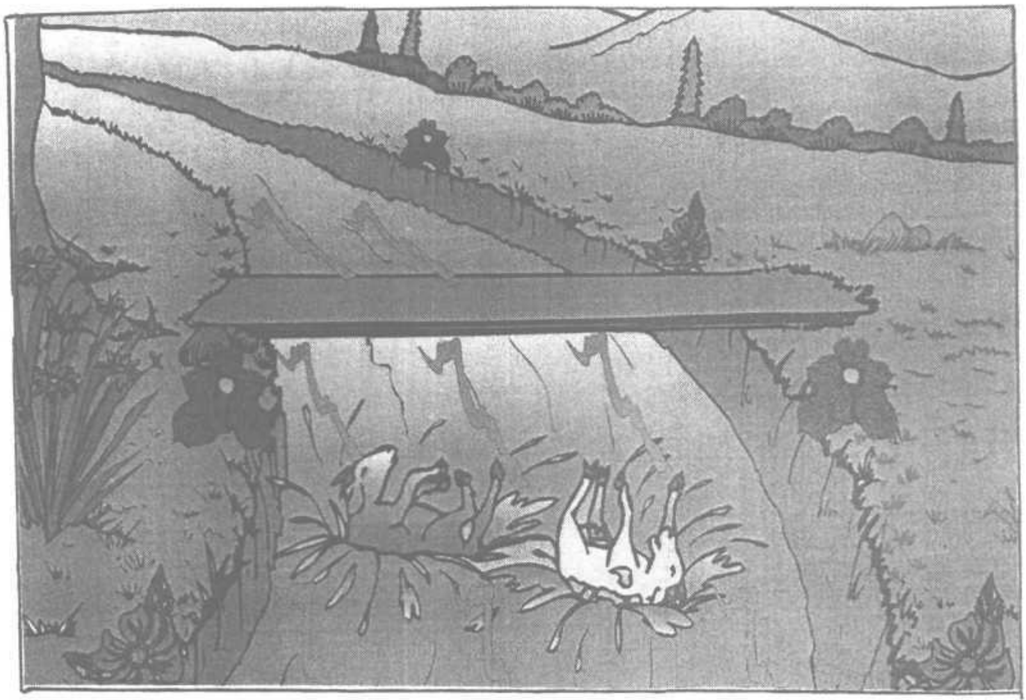
STORY SEQUENCING
LEVEL-I



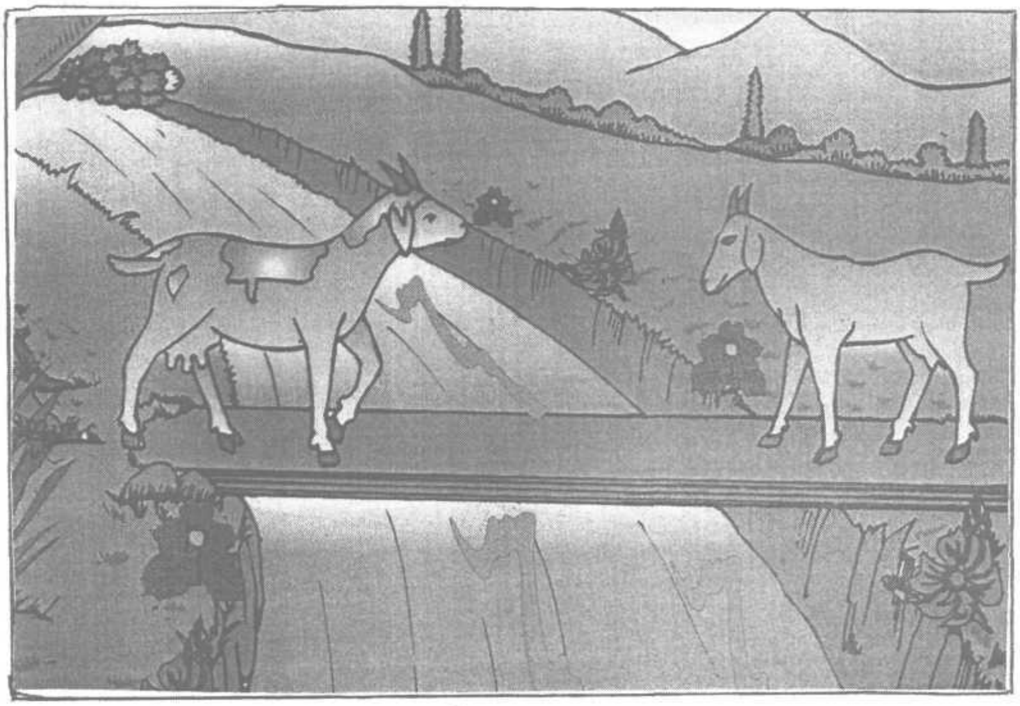
Ia



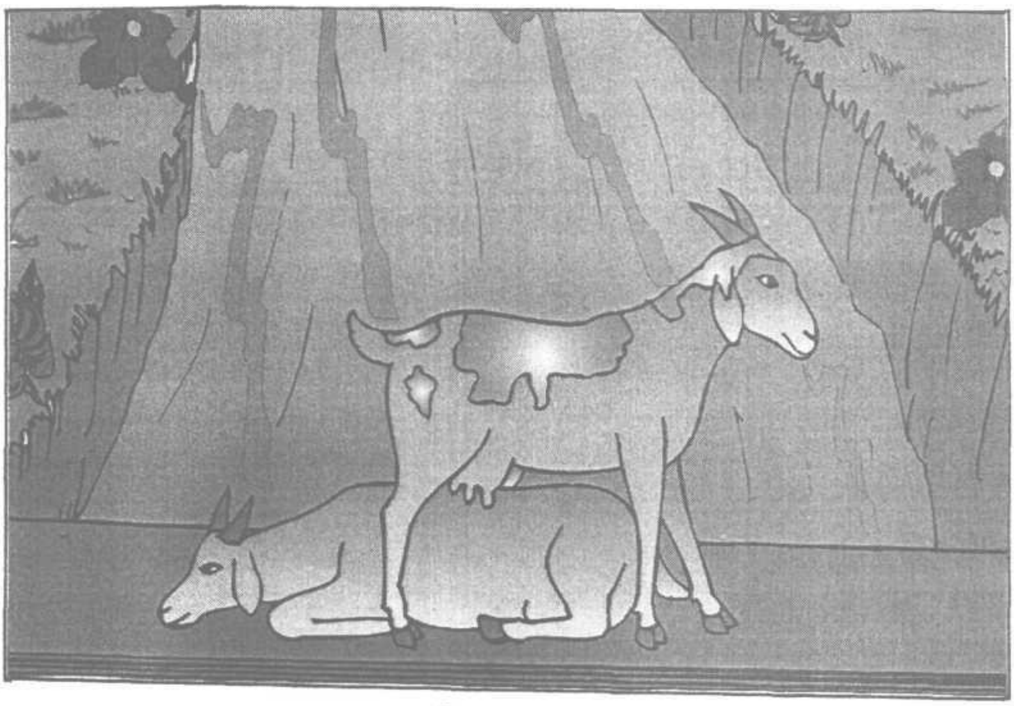
Ib



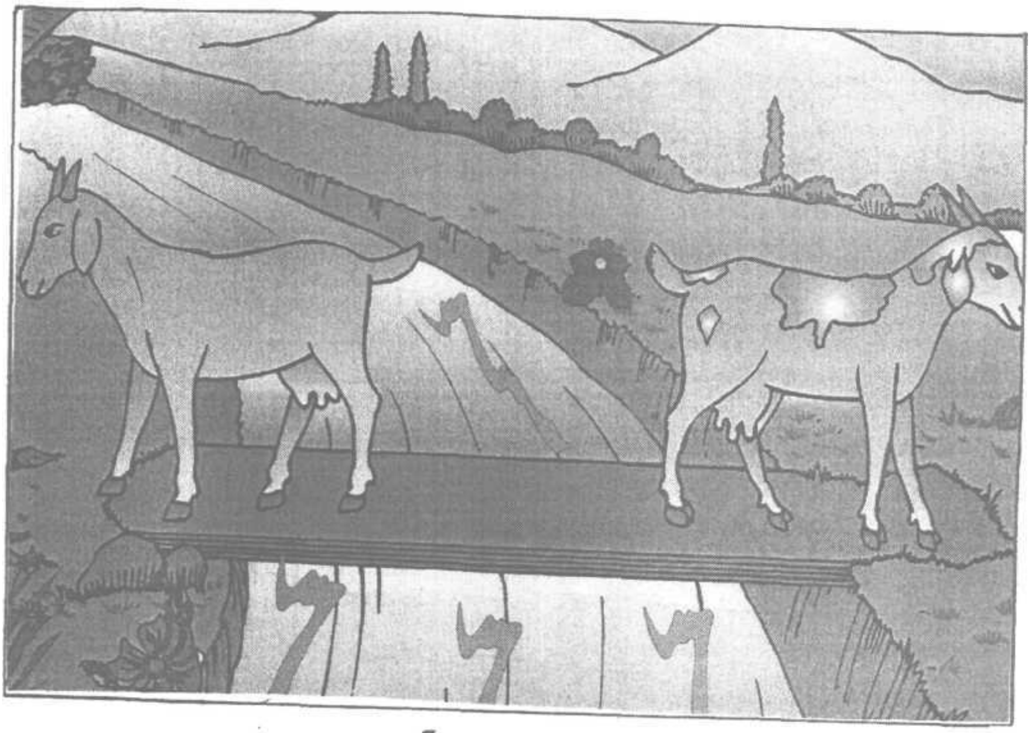
Ic



Id



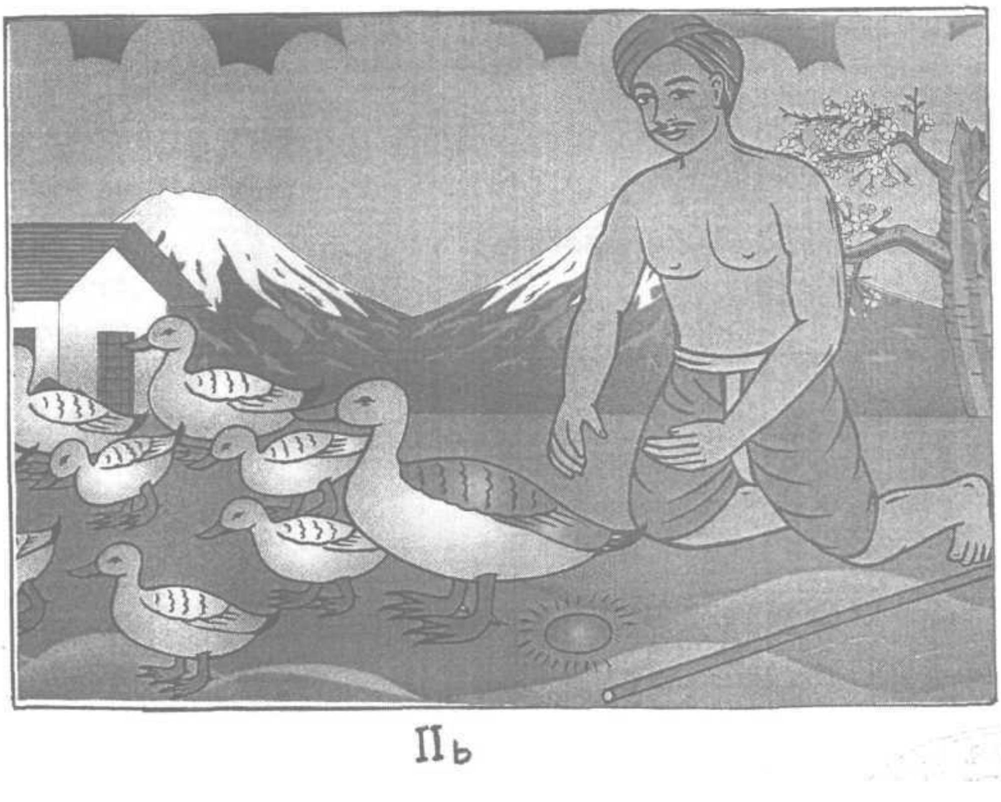
Ie



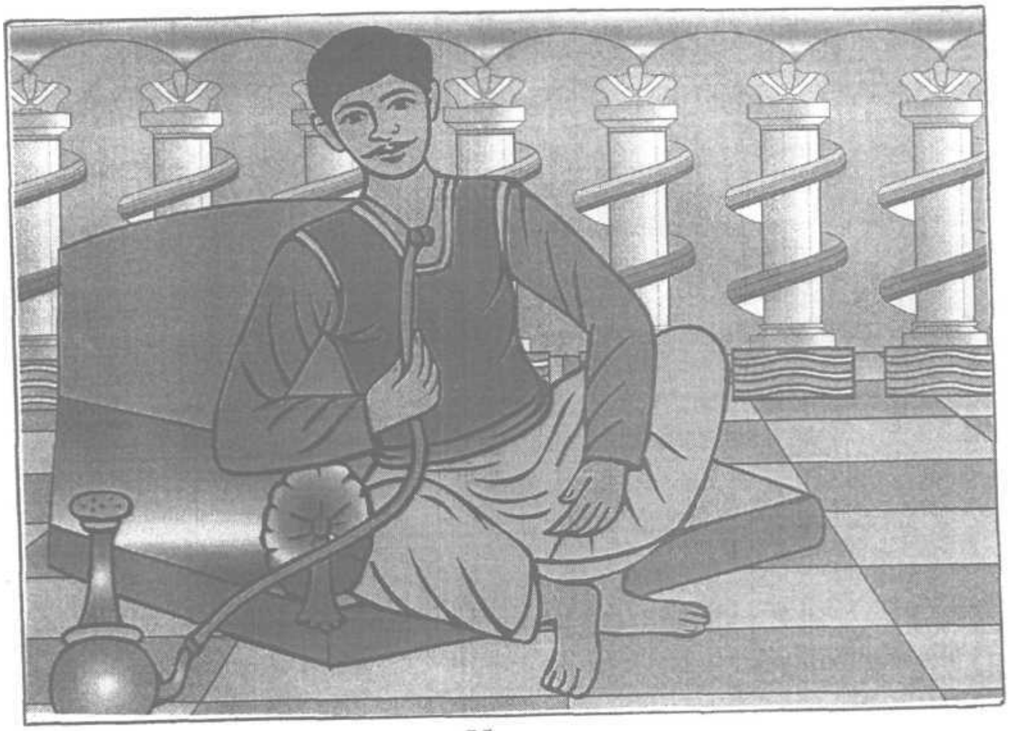
If

LEVEL-II

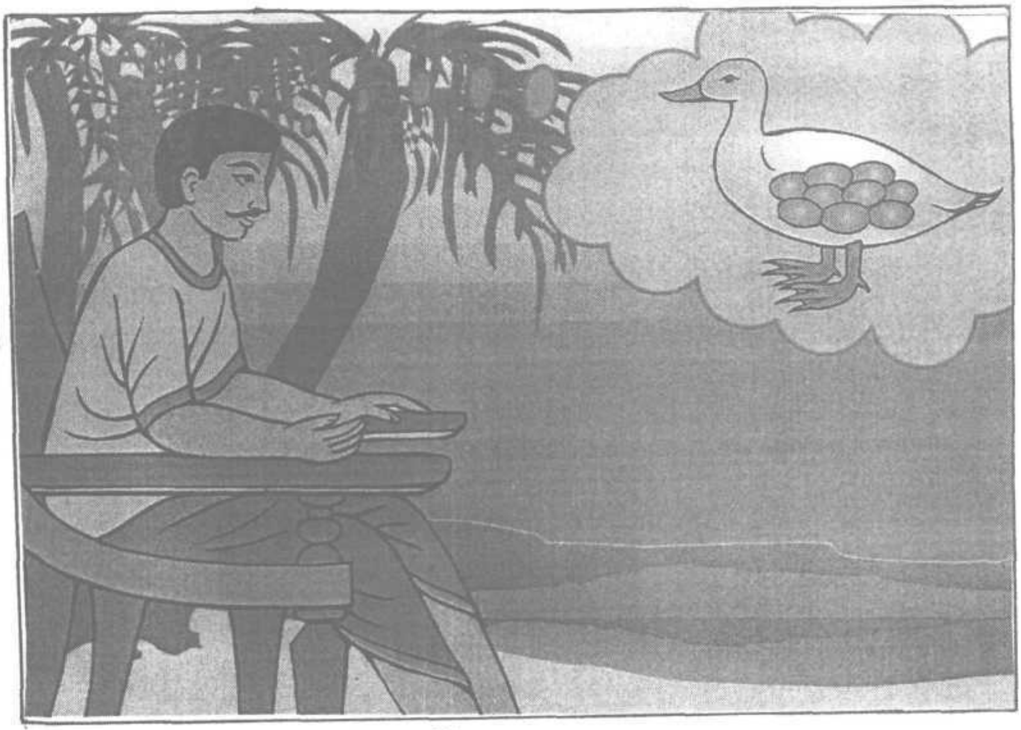
IIa



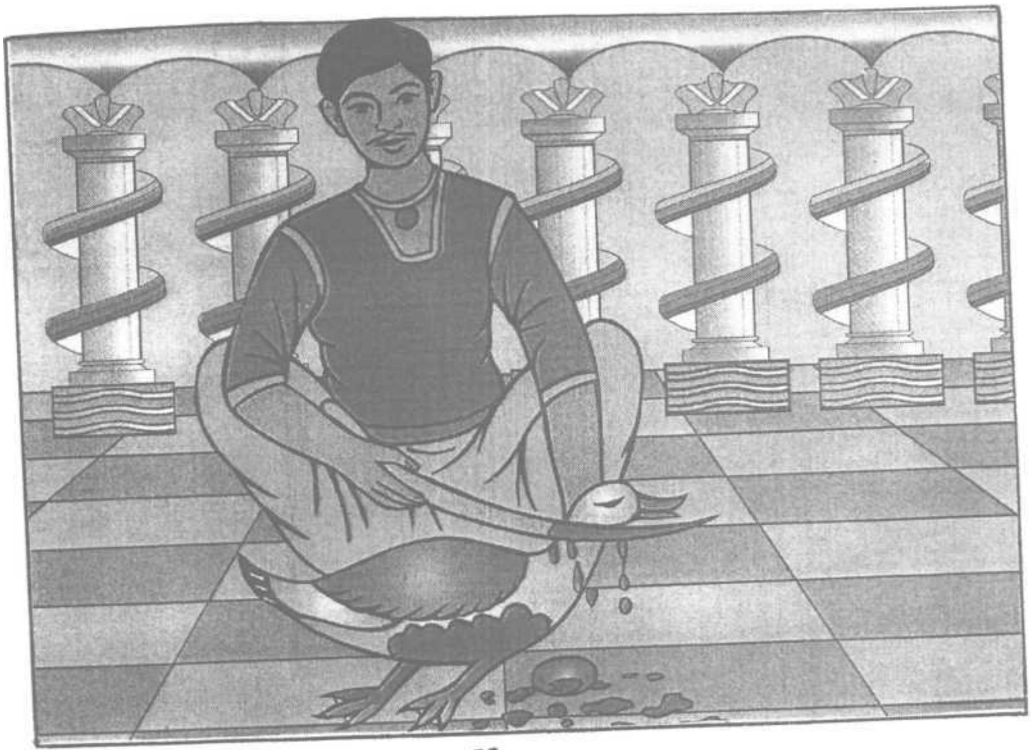
IIb



IIc

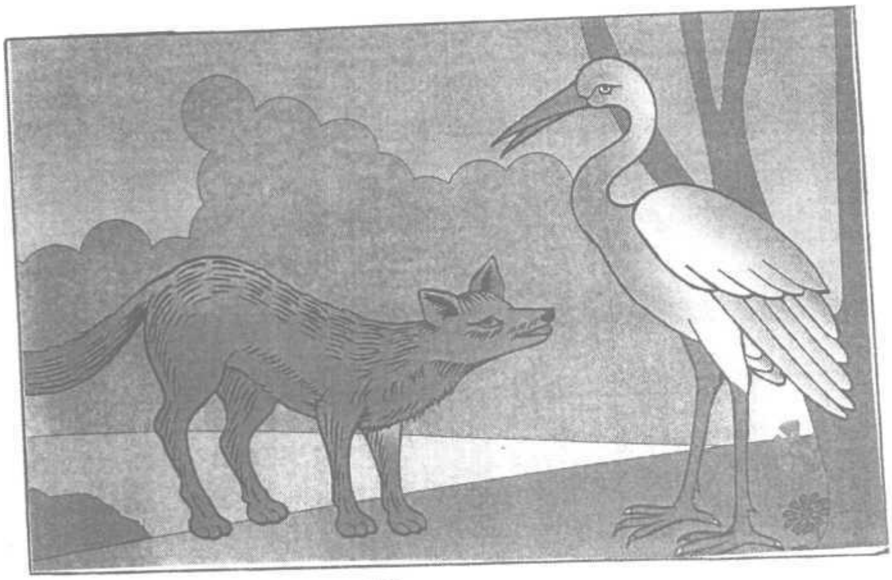


IId



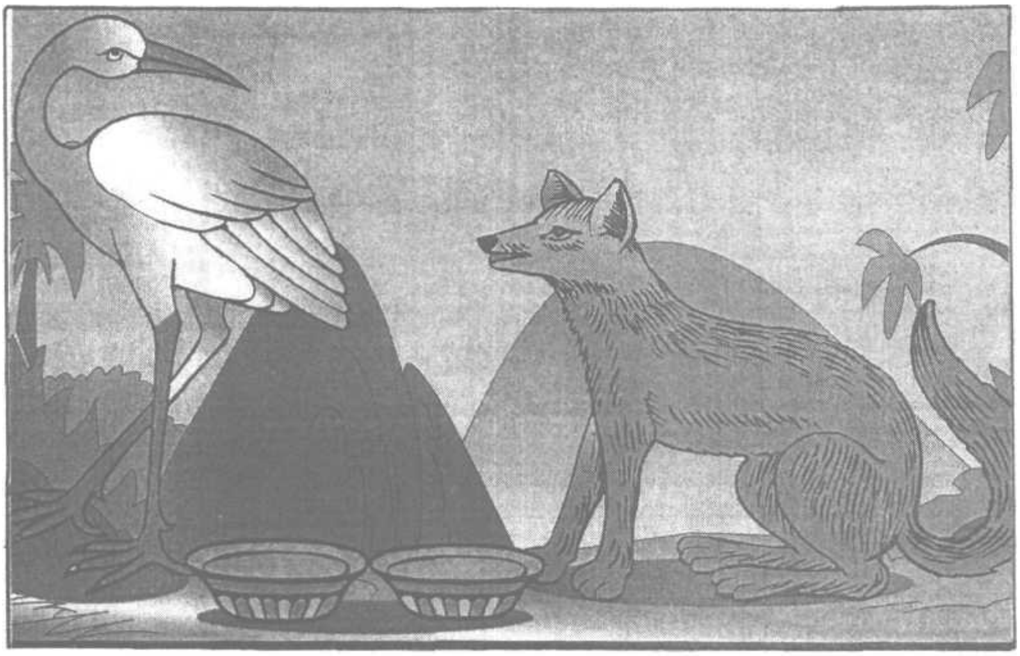
IIe

IIf

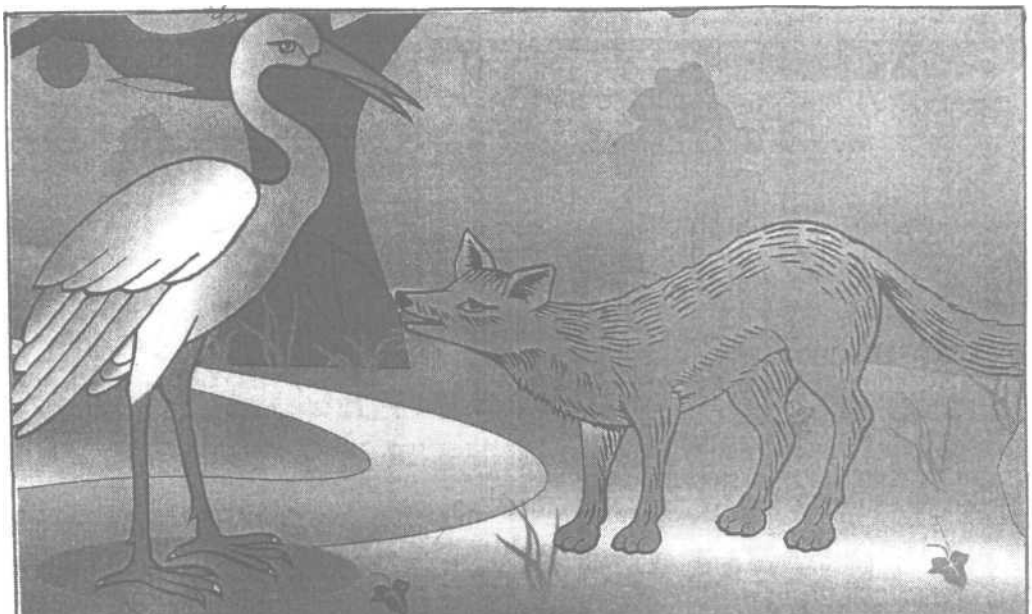


IIIa

IIIb

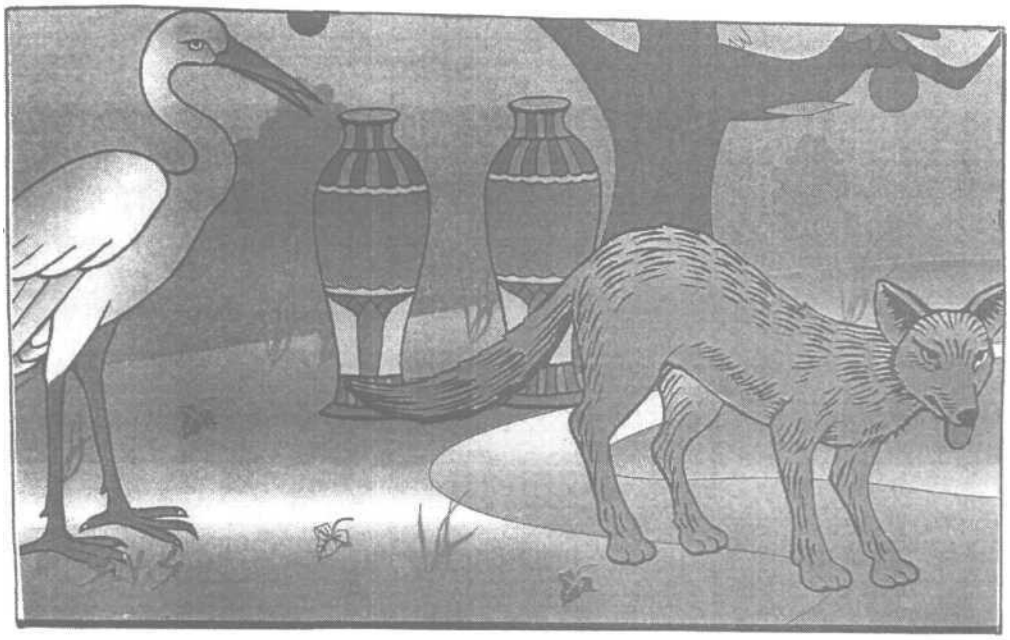


IIIc



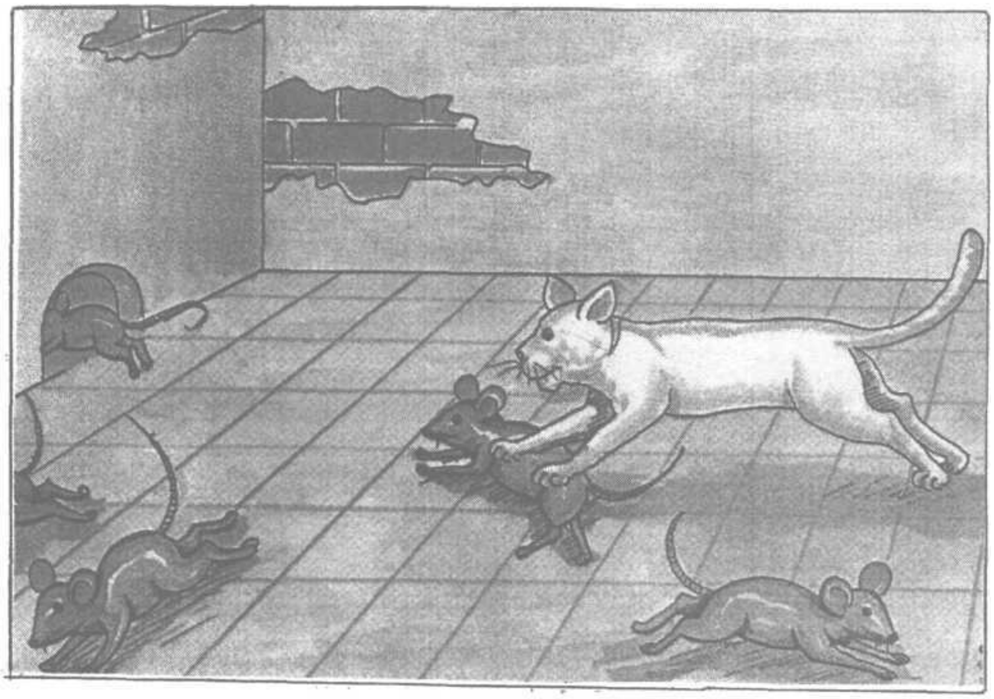
IIId

III e

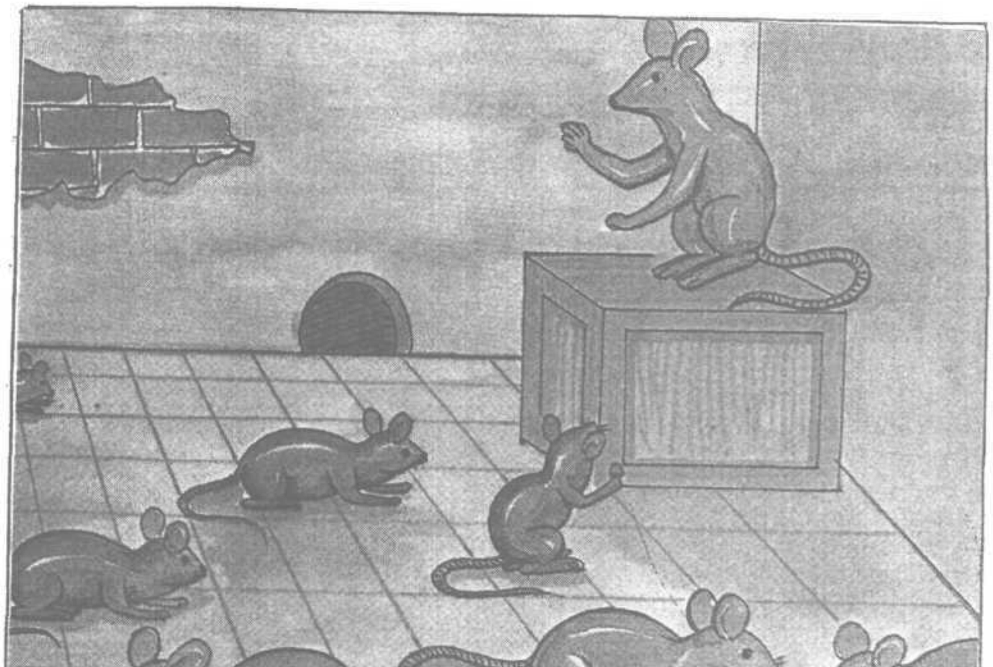


III f

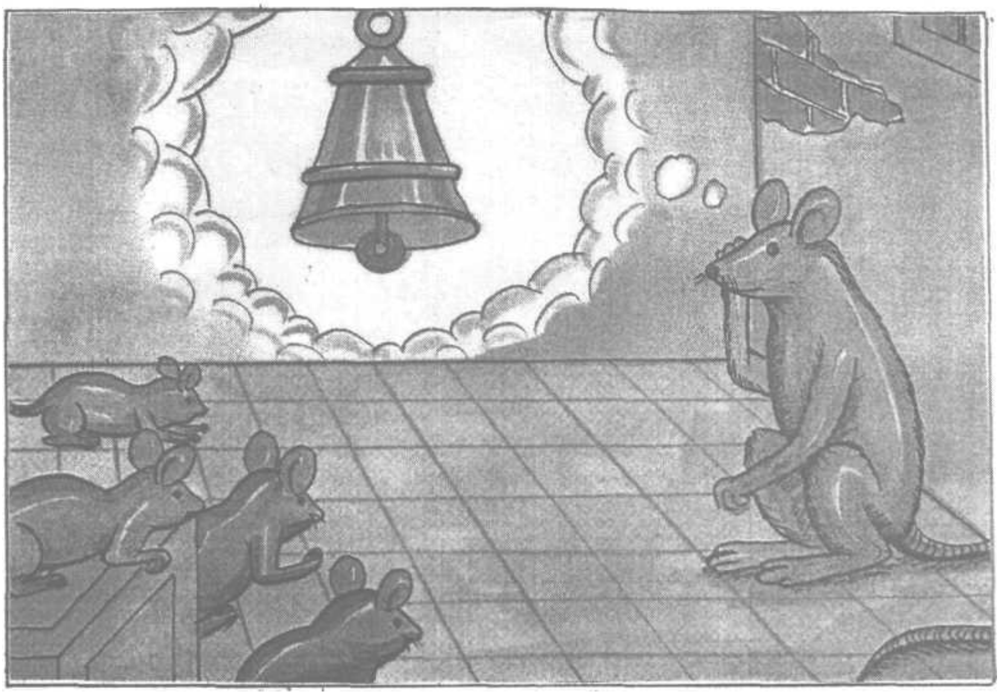
LEVEL - IV



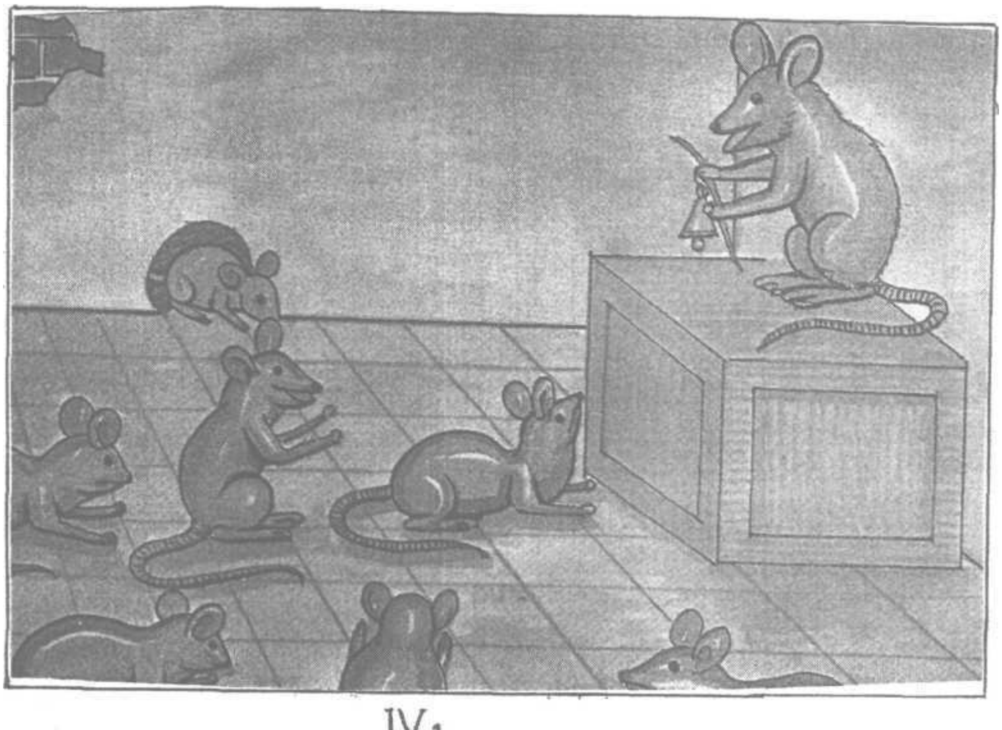
IVa



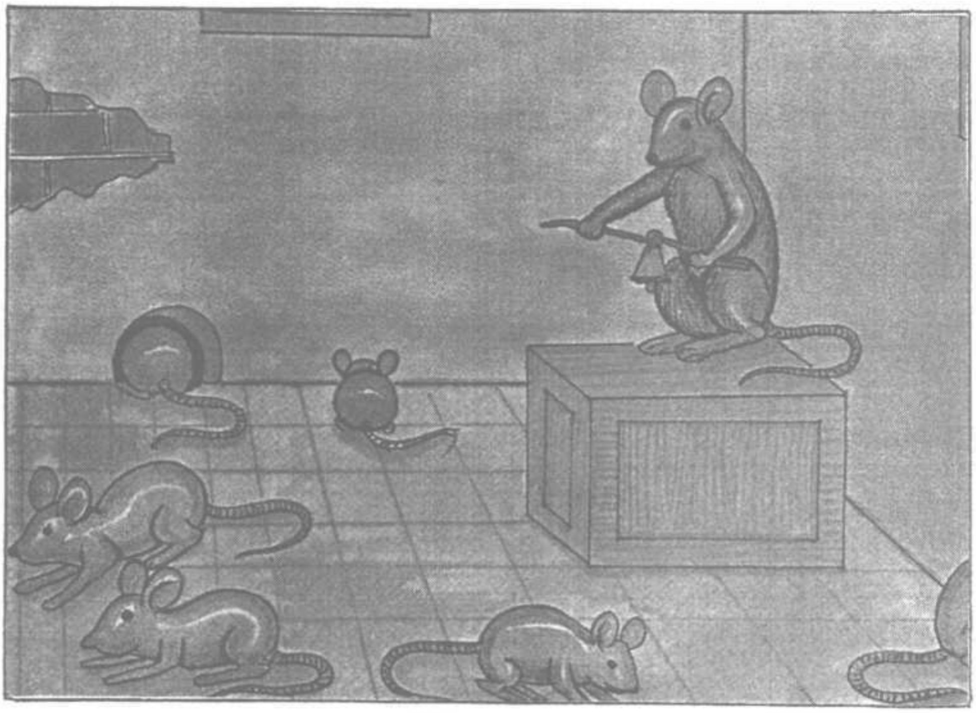
IVb



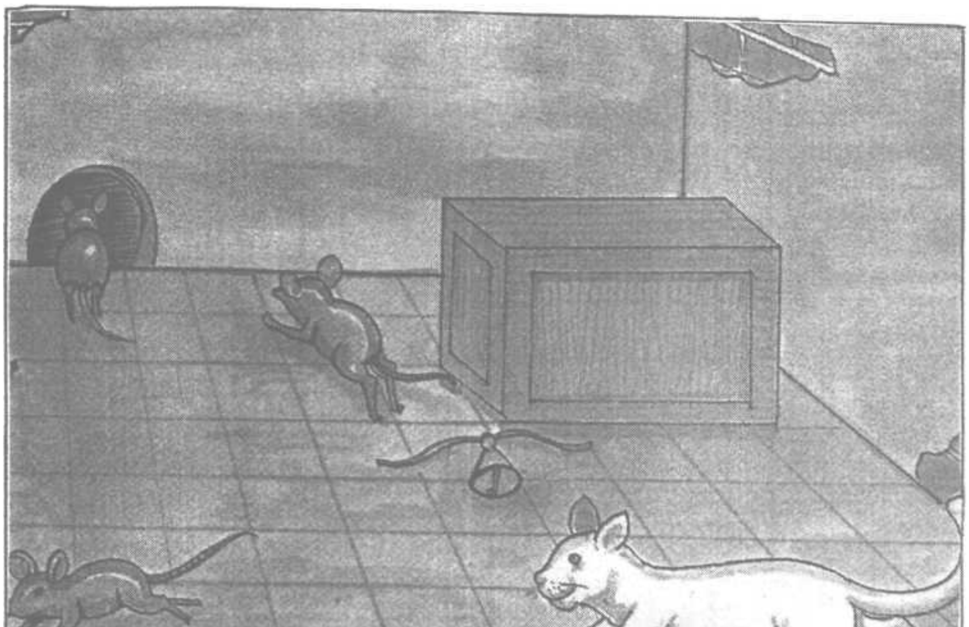
1V$_C$



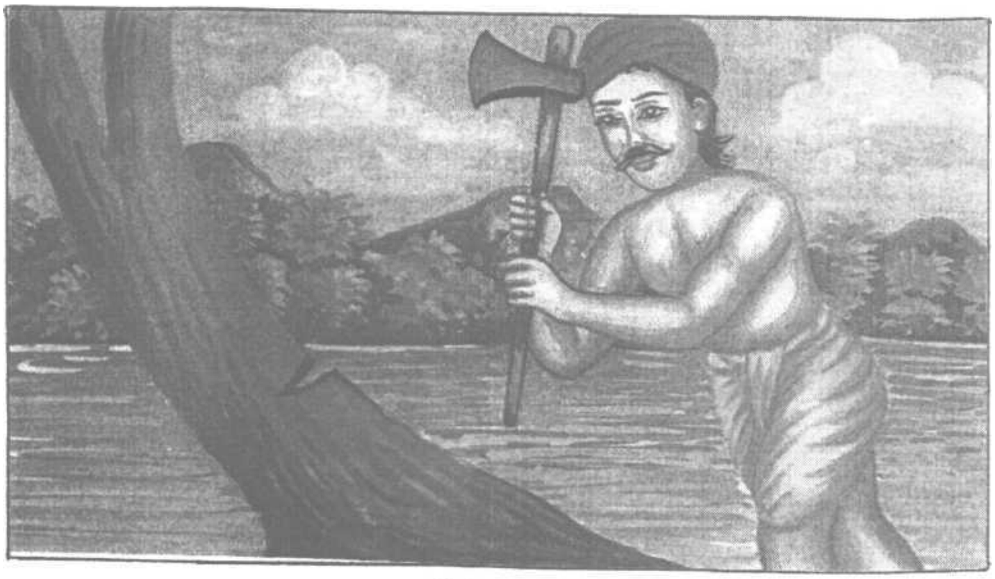
IVa



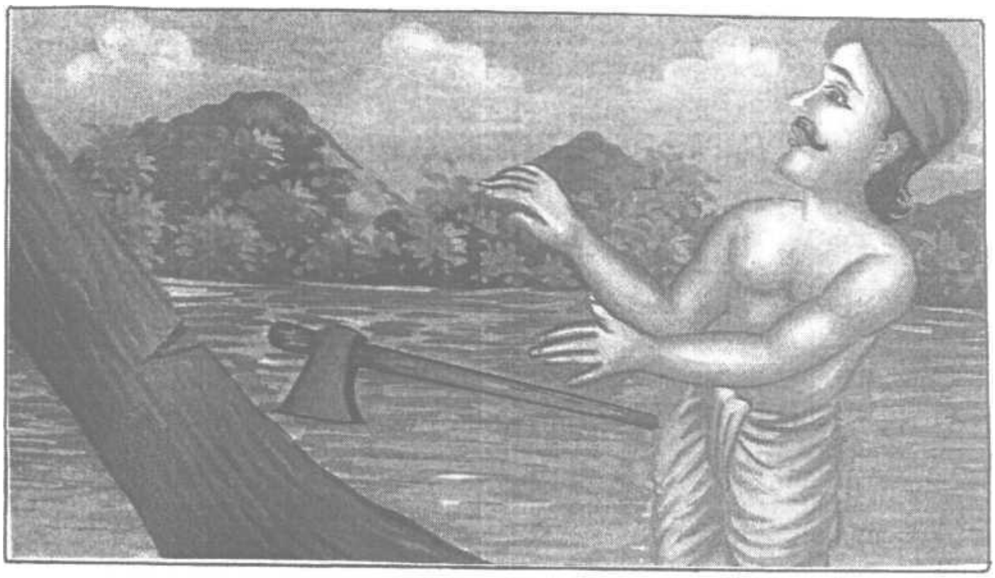
IV_e



IV_f

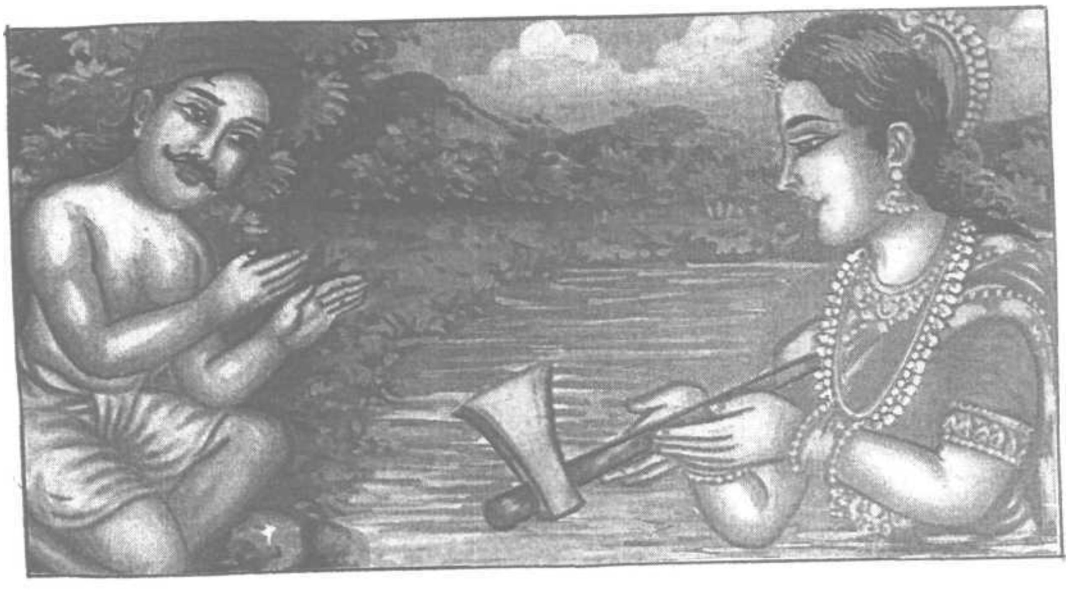


Va

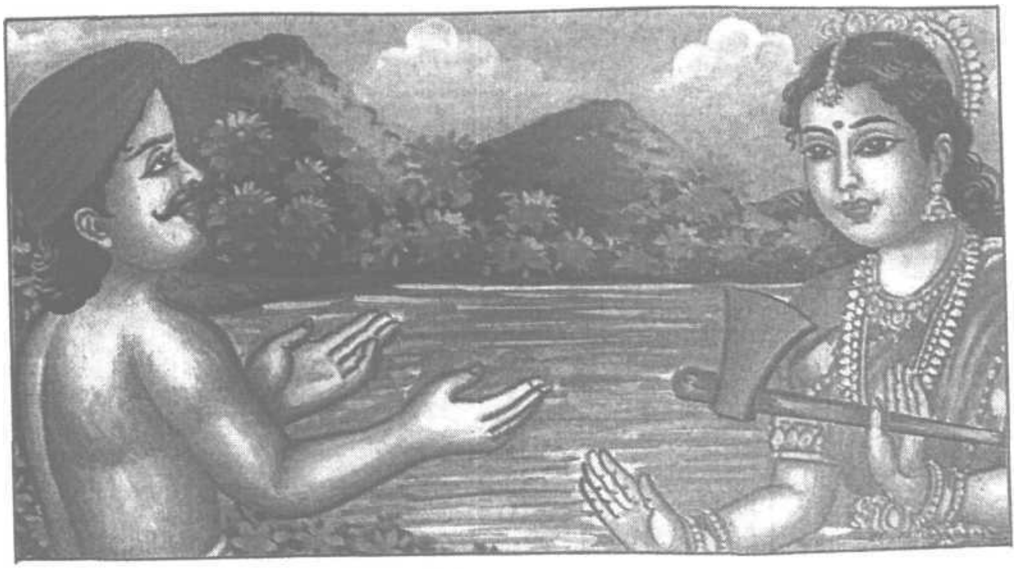


Vb

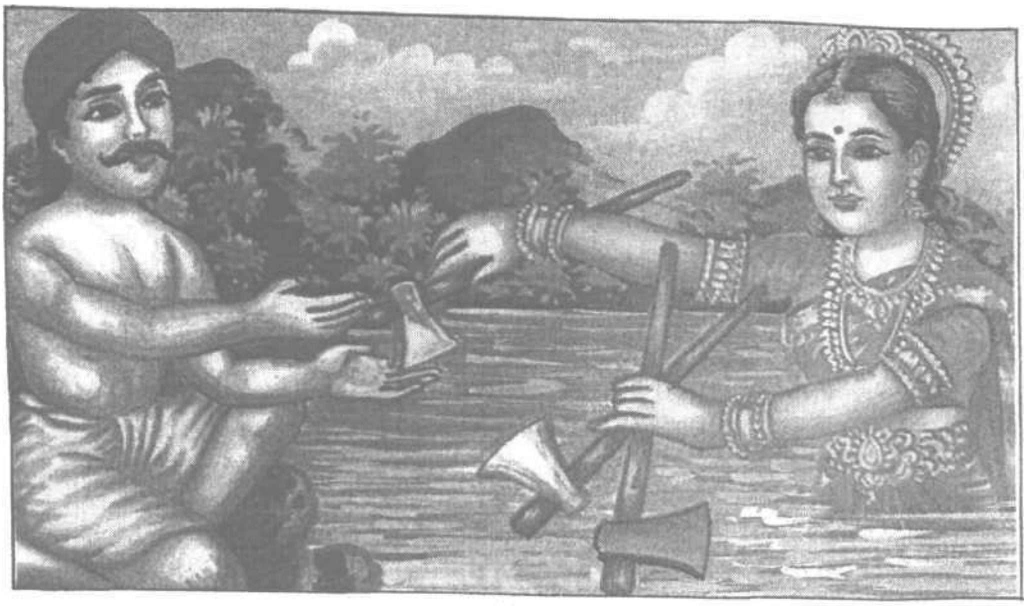
Vc



Va



Vf



Vg

Vh

ASSOCIATION TASK
LEVEL-I

Ia

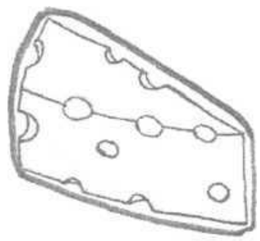
Ib

Ic

Id

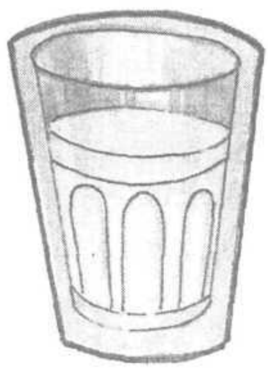
LEVEL - II

IIa



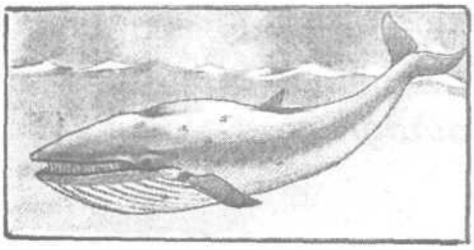
IIb

IIc



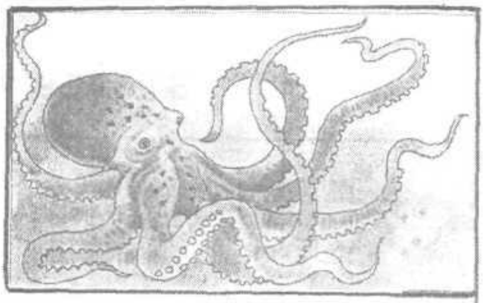
IId

LEVEL - III

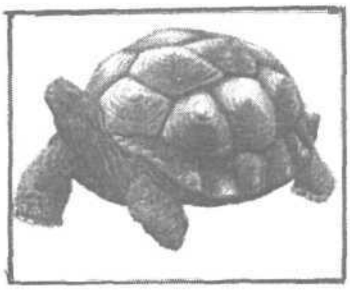


III b

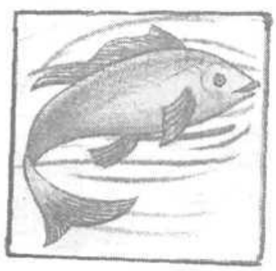
III a



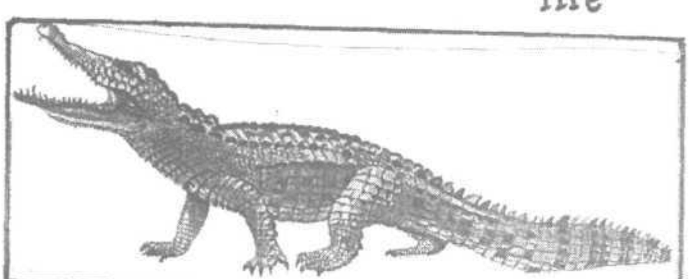
III d



III c

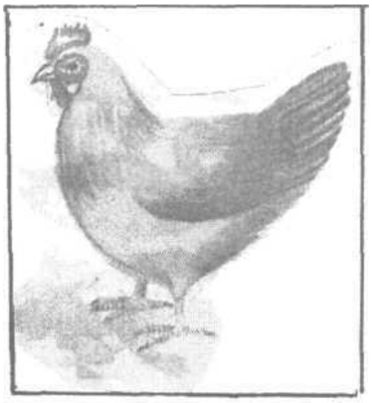


III e



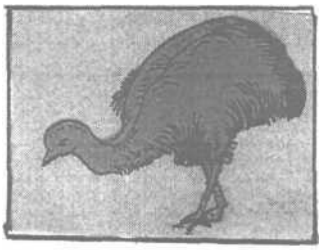
III f

LEVEL-IV



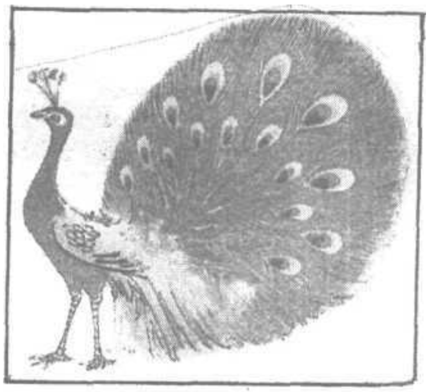
IVa

IVc



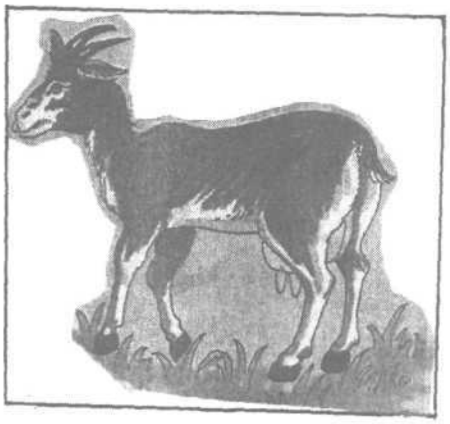
IVb

IVe

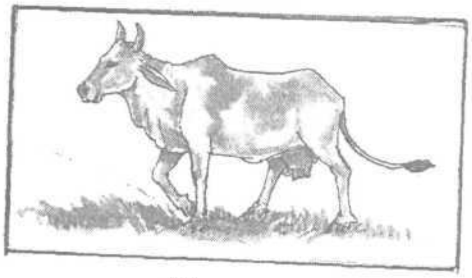


IVd

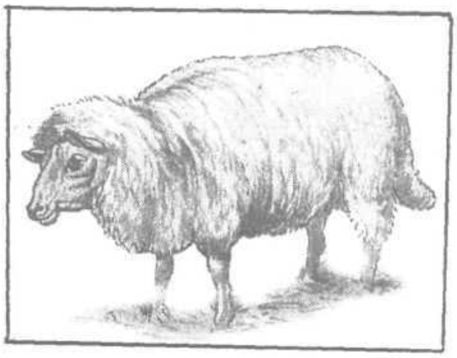
LEVEL-V



Va

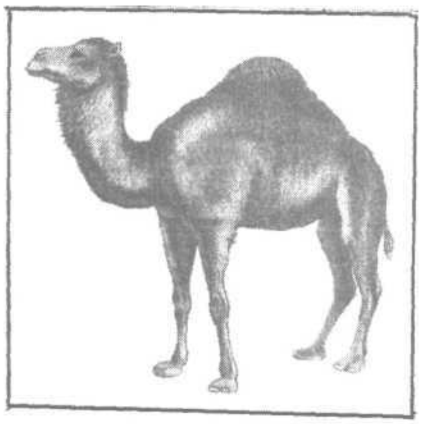


Vb

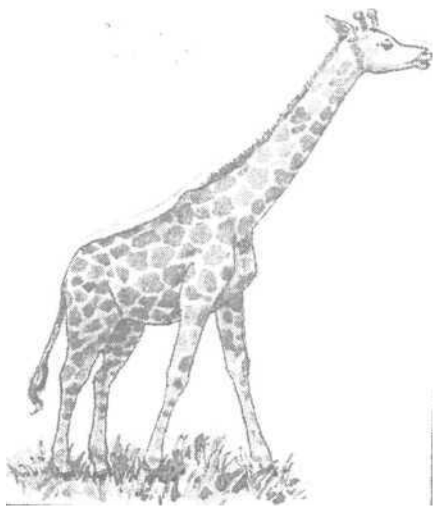


Vc

Vd

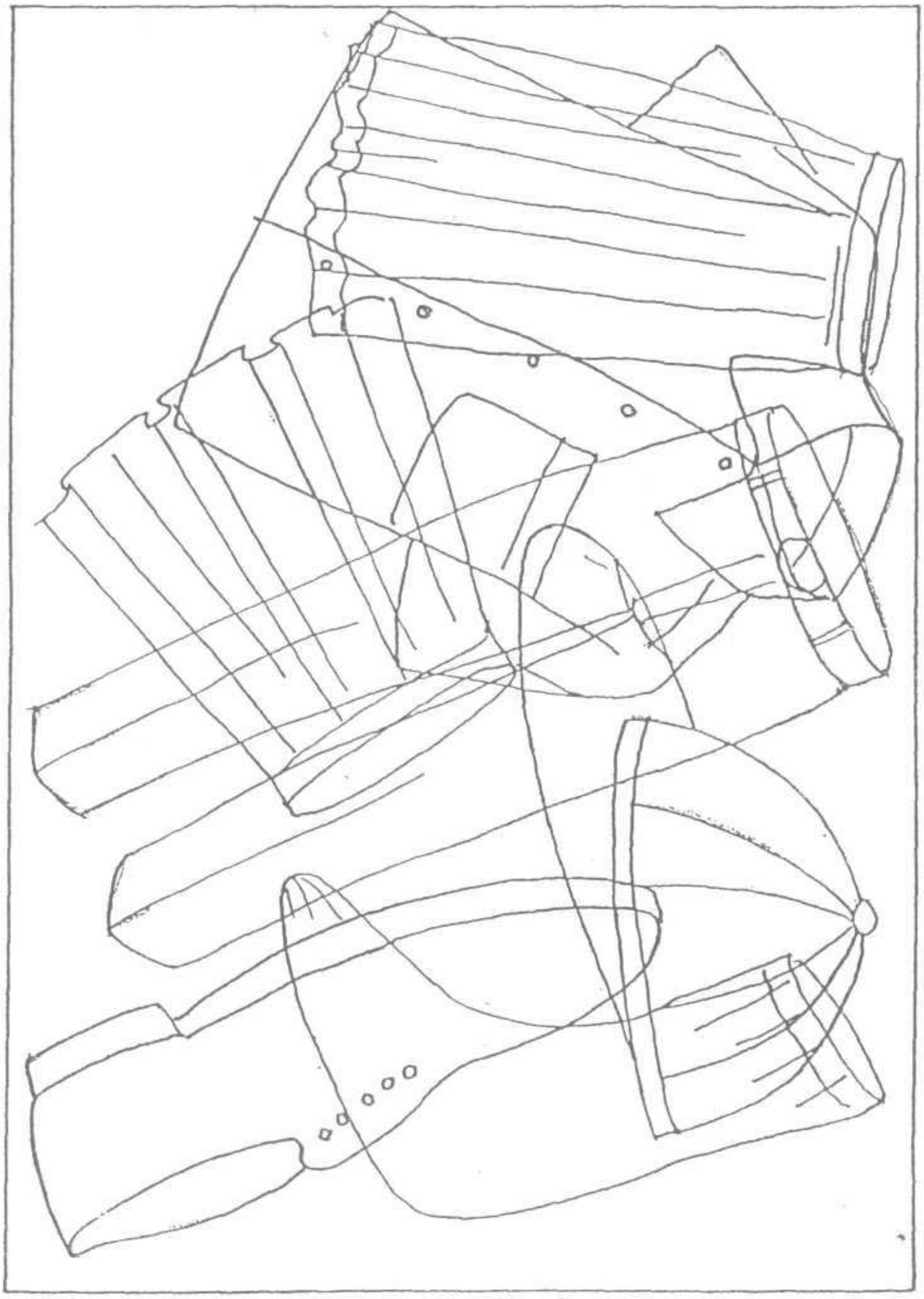


Ve



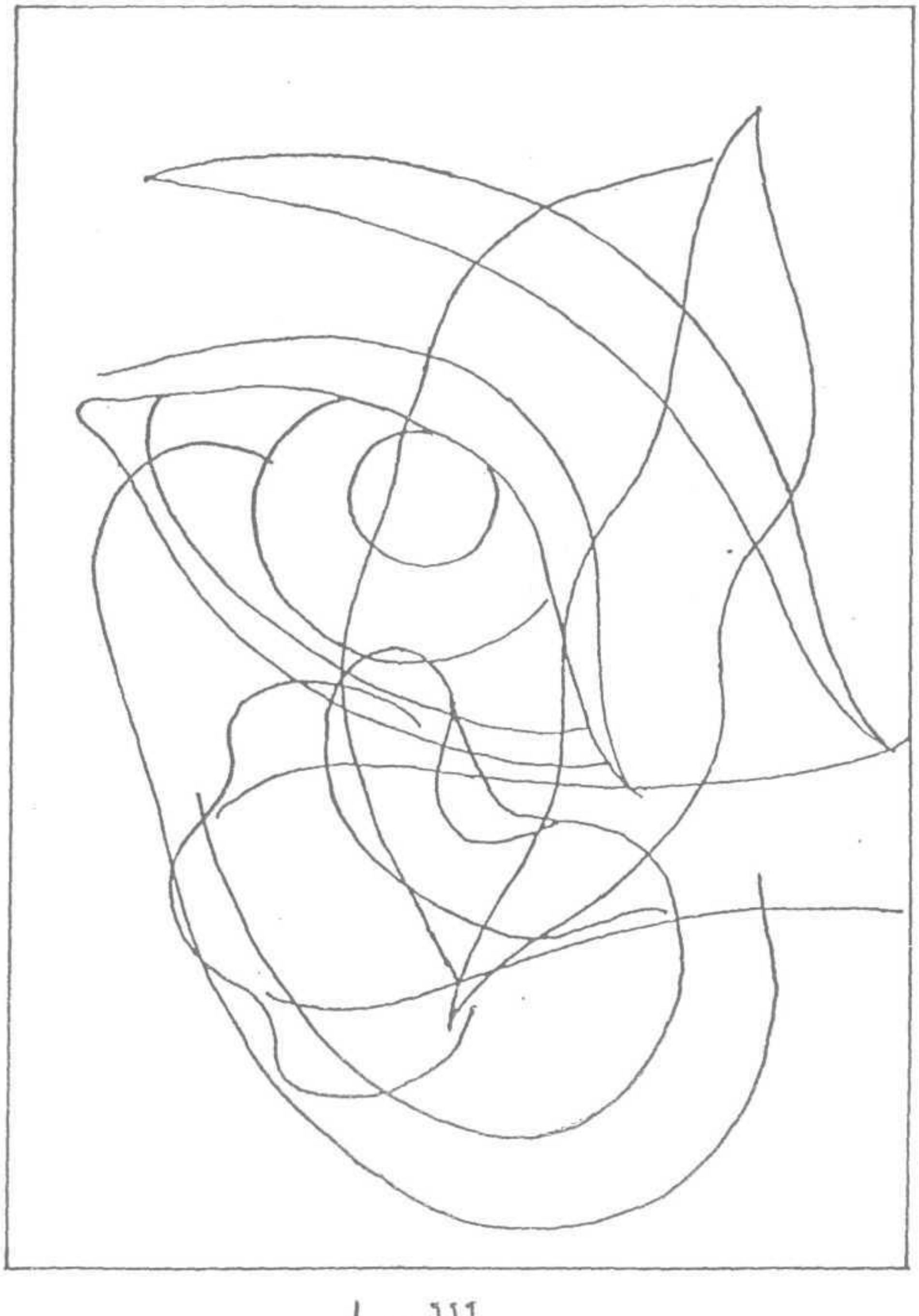
Vj

LEVEL - II



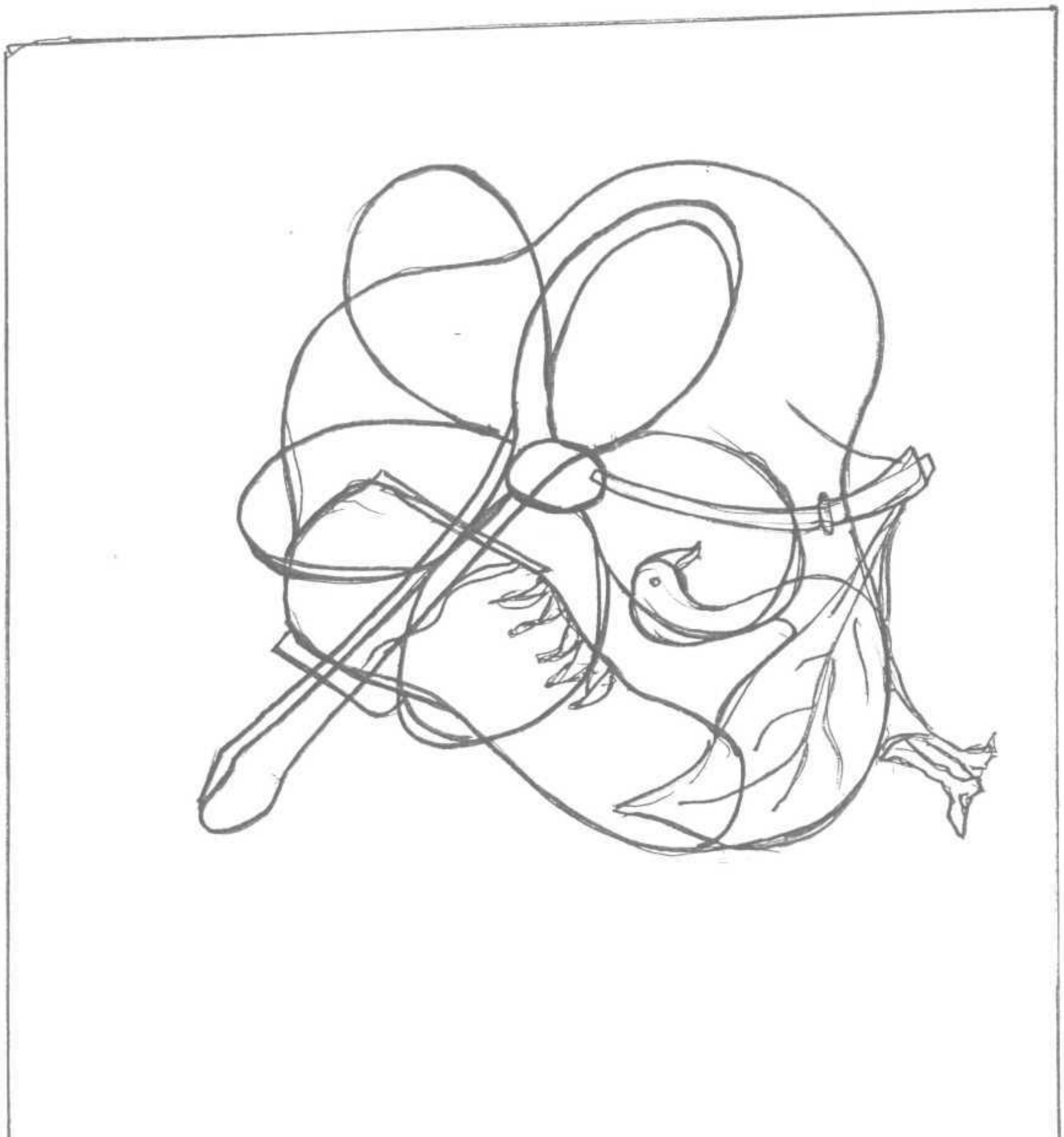
L - II

LEVEL - III



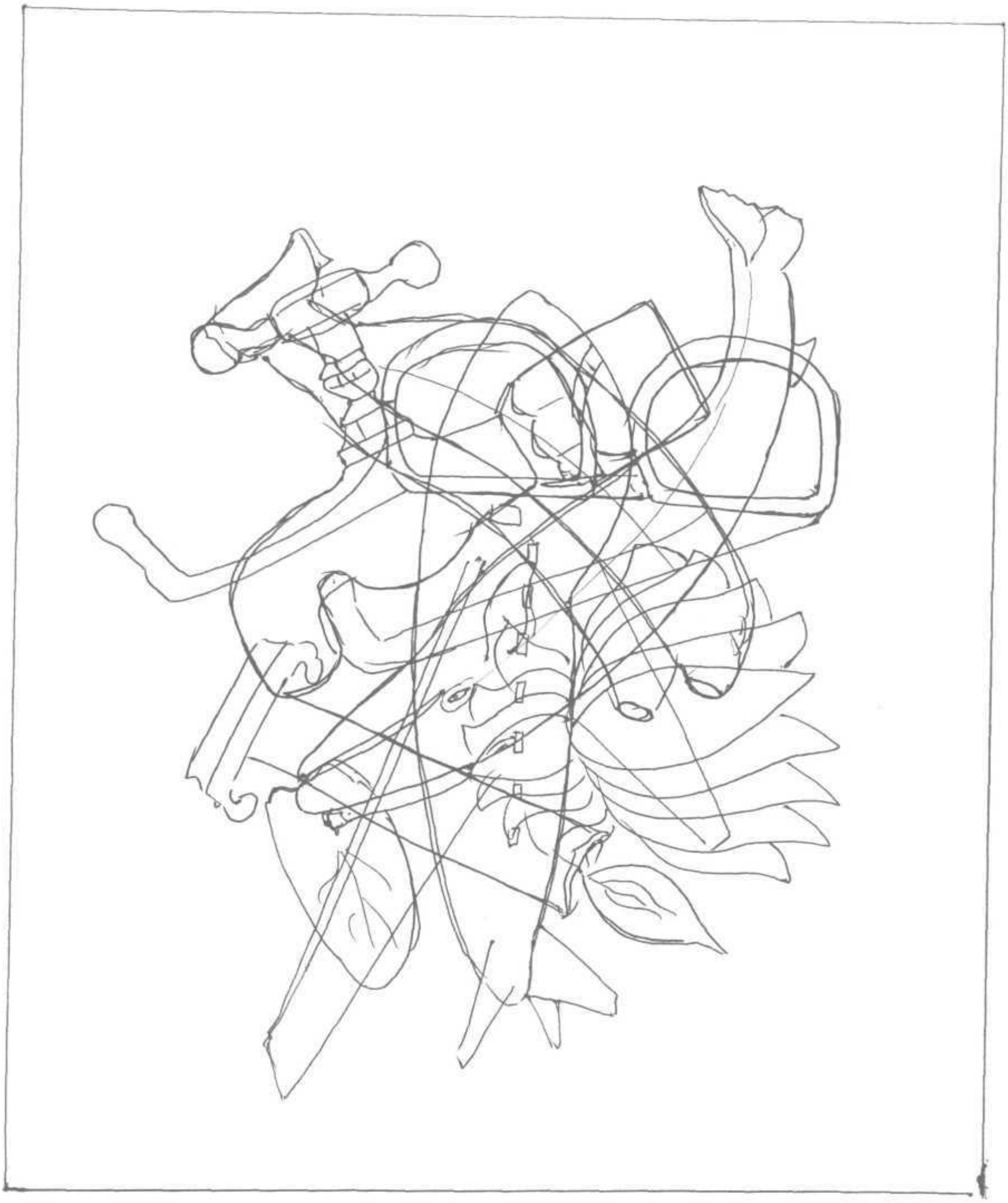
L - III

LEVEL-IV



L-IV

LEVEL - V

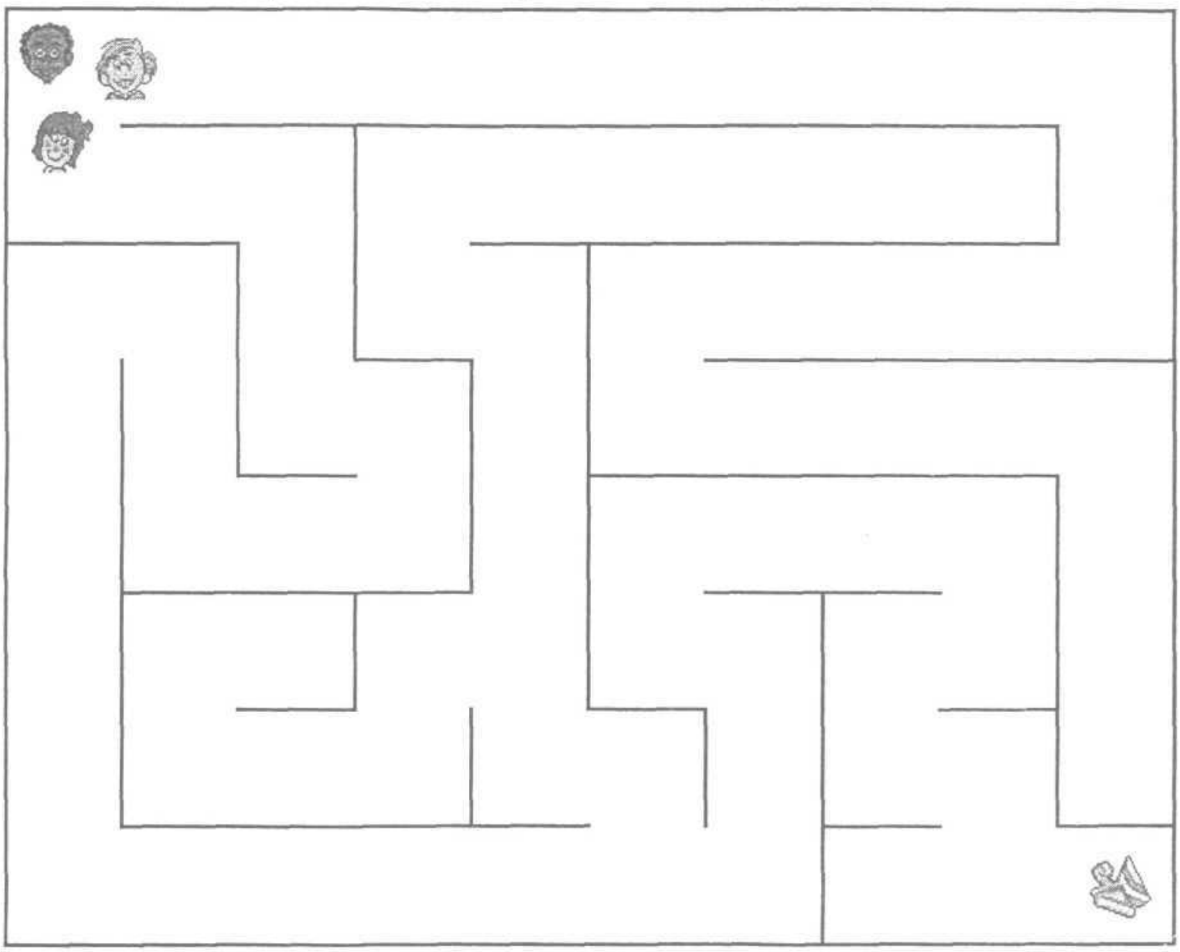


L - V

MAZES

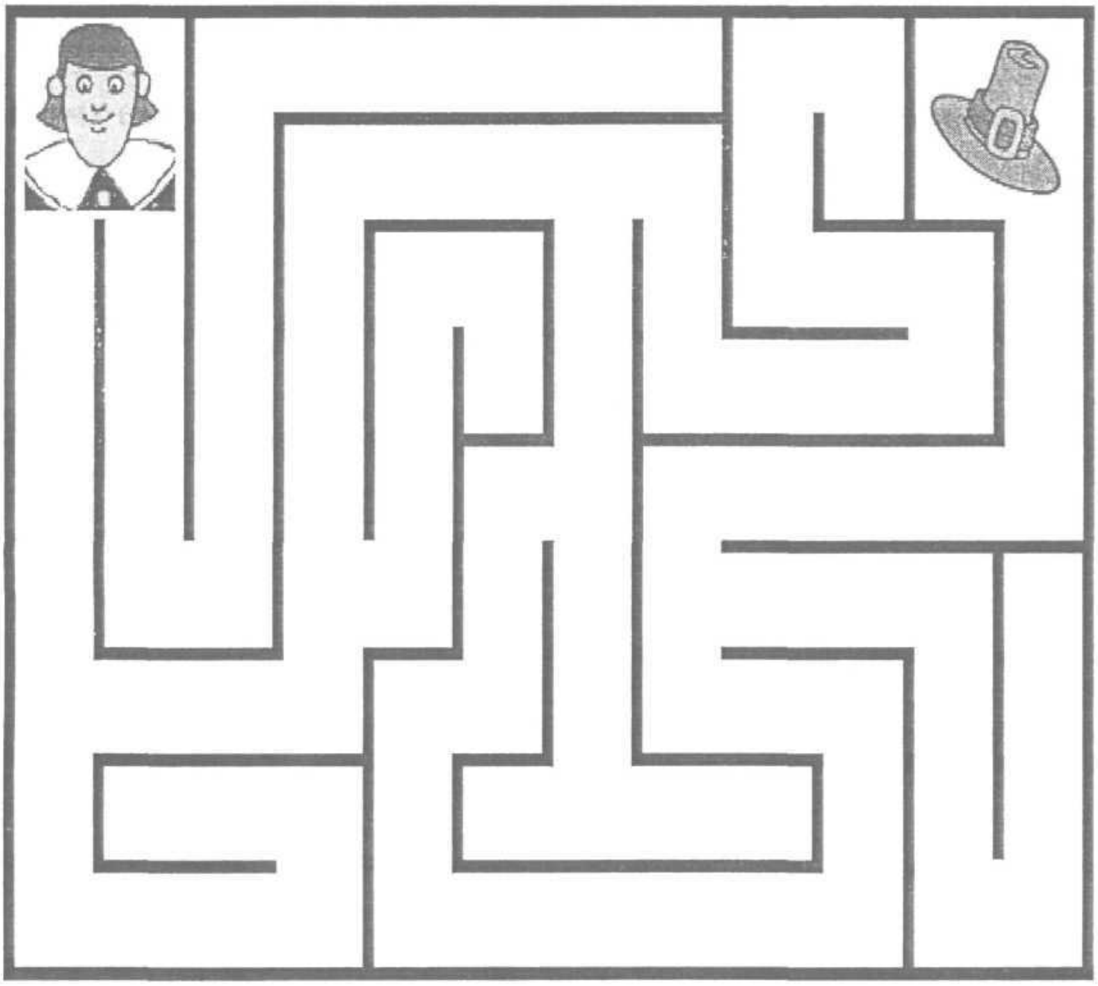
LEVEL - I

Help the kids get to the party!



L - I

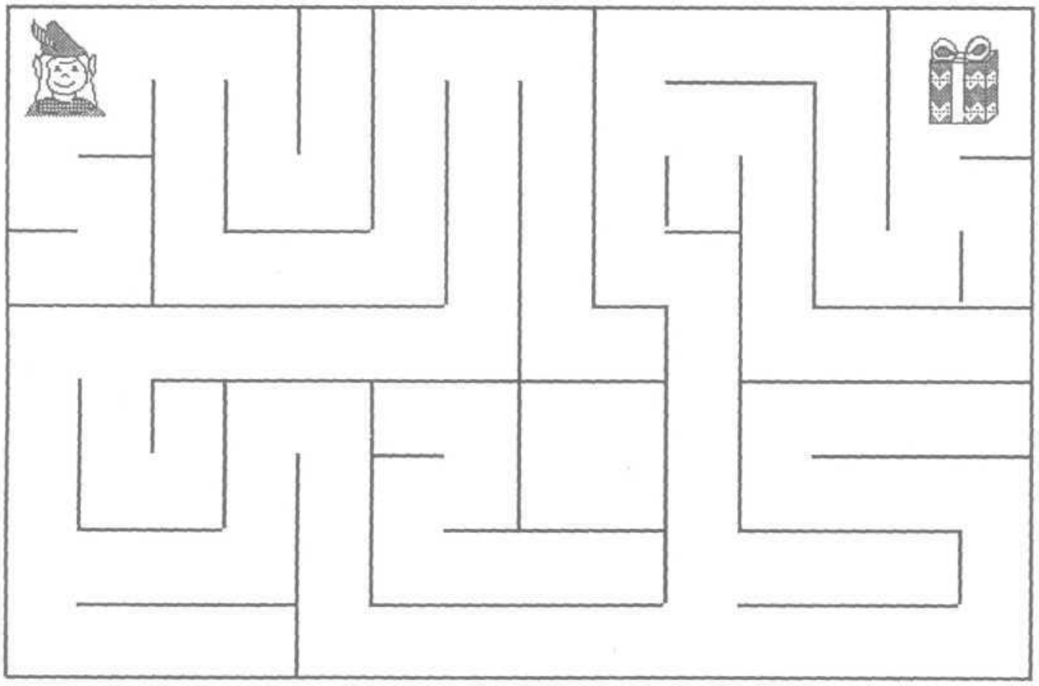
LEVEL - II



Help the Pilgrim find his hat

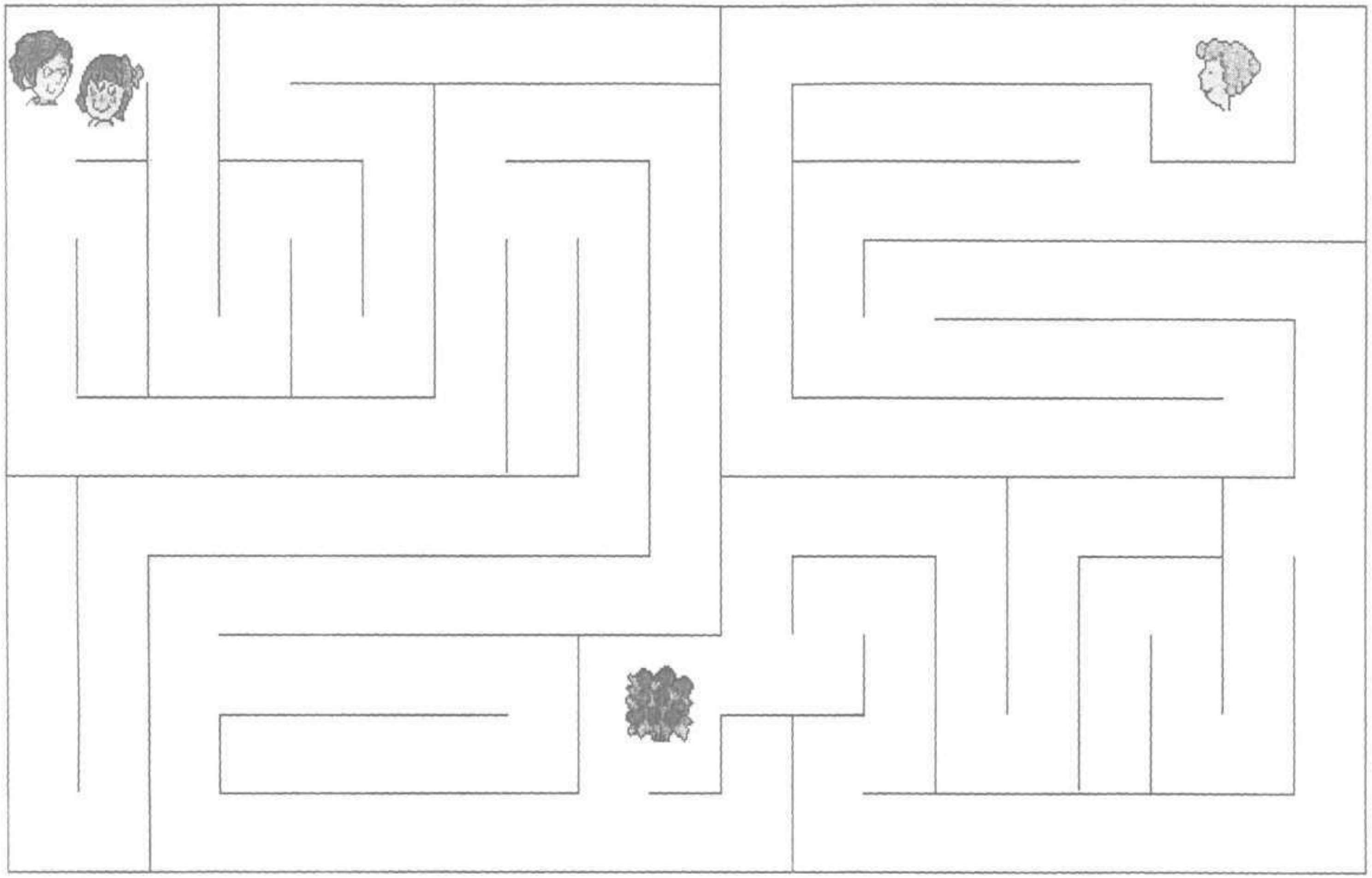
L - II

LEVEL-III



Elf is looking for the lost gift

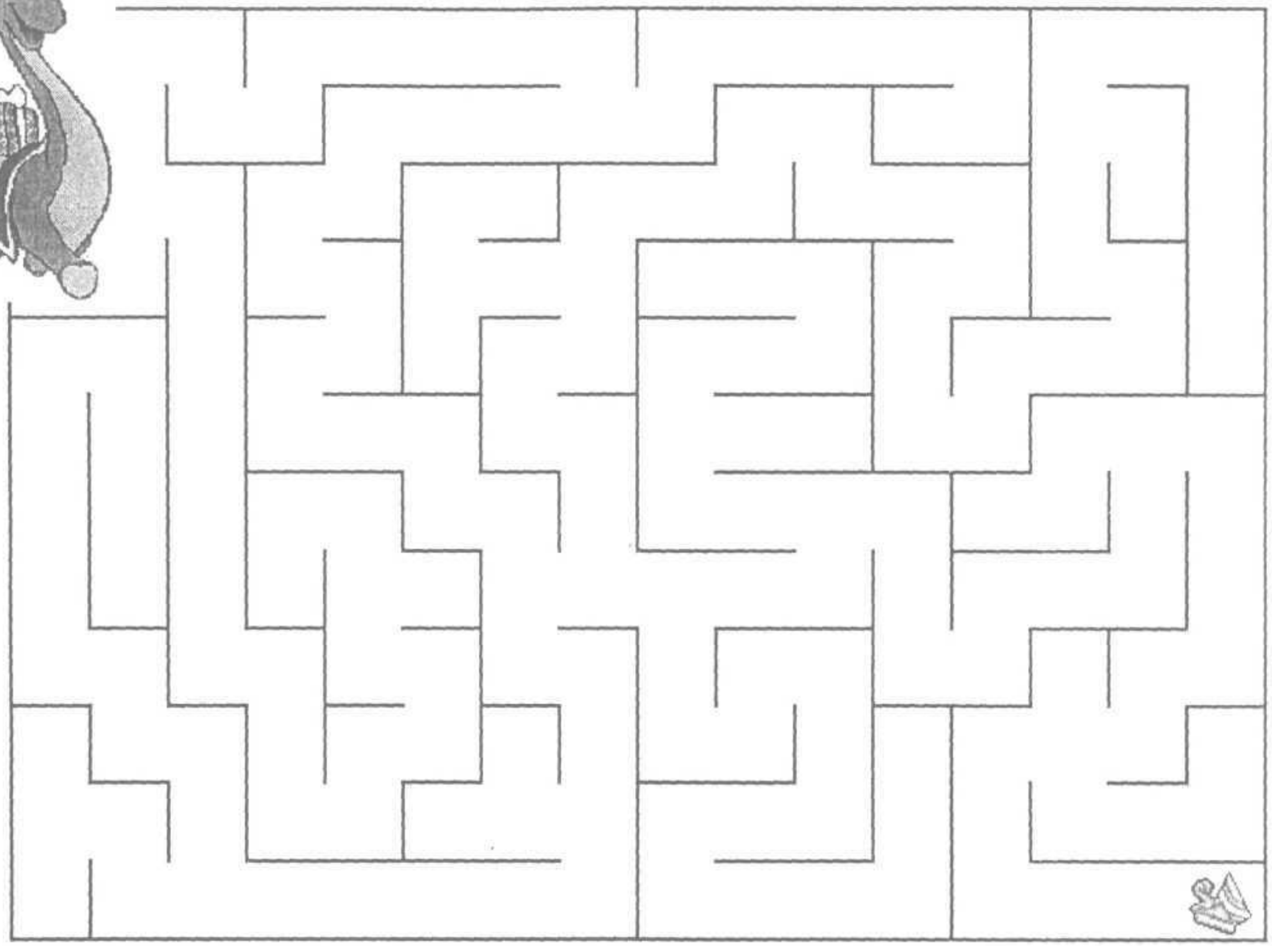
L - III



Help the children find the roses and bring them to Mom

LEVEL - IV

Help the dinosaur go to the party



V - 7

LEVEL - V

APPENDIX - III

SCORE SHEET

Name:

Age/Sex:

I. ATTENTION/ DISCRIMINATION:

Subtest	Test item	Subject Score	Maximum Score
Auditory	a. Digit Count Test		**5**
	b. Sound Count Test		**10**
	c. Auditory Word Discrimination		**10**
Visual	a. Odd One Out Test		**5**
	b. Letter Cancellation		**10**
Total:______/ 50.	c. Visual Word Discrimination		**10**

II. MEMORY:

Subtest	Test item	Subject Score	Maximum Score
Auditory	a. Digit Forward Span		**5**
	b. Word Recall		**10**
	c. Digit Backward Span		**5**
Visual	a. Alternate Sequencing		**5**
	b. Picture Recall Task		**10**
Total:_____ /50.	c. Story Sequencing		**15**

III. PROBLEM SOLVING:

Subtest	Test item	Subject Score	Maximum Score
Auditory	a. Predicting Cause		**20**
	b. Predicting Outcome		**20**
	c. Compare & Contrast		***20***
Visual	a. Association Task		**5**
	b. Overlapping Test		**30**
	c. Mazes		**5**

Total:______/100.

Total Score: Attention/ Discrimination + Memory + Problem Solving

= 50 + 50+100.

= 200.